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BUILDERS' ESTIMATES AND PRICING DATA

THEIR PREPARATION AND ANALYSIS

BY

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AUTHOR'S PREFACE

IN submitting this work, the author is well aware that practical Estimating Surveyors have no need for text-books on pricing, as estimating for builders' work is a task calling for many years of experience combined with a sound knowledge of Building Construction and Quantity Surveying. Young surveyors, however, frequently find difficulty in obtaining instruction as to the preparation of data and prices, and it is hoped that this book will be of assistance to them, although perhaps a few of the items and methods may be new to some practical men. It is well known that a builder's estimating surveyor should have a thorough knowledge of quantities, but it is only during recent years that attention has been drawn to the fact, that it is equally important for the quantity surveyor to have a good general knowledge of estimates and their preparation. Various technical examinations now require a considerable knowledge of the preparation of prices, and in 1924 the Surveyors' Institution Examination for Quantity Surveyors contained the new subject of "Analysis of Pricing," which is now compulsory for all candidates in Sub-Division 3 (Quantities). By the courtesy of the Council of the Surveyors' Institution it has been possible to reproduce the papers, and it is hoped that candidates for the Examination will find this inclusion of use. The City and Guilds of London Institute also conducts Examinations in Pricing Builders' Work, and by the courtesy of the Department of Technology the Examination papers are given herein. The examinations held by the Institute

of Builders also require a sound knowledge of the principles of estimating.

The author, although in practice as a quantity surveyor, has had considerable experience in the preparation of builders' estimates, and much of the information contained herein was used for that purpose; it has, therefore, stood the test of practice. Later it was used for the purpose of instructing pupils at Technical Institutes. Many requests from former pupils for a text-book indicated a need in this direction, and it was decided to publish the lessons in book form.

Owing to the frequent variations in wages the data have needed constant revision, but the rates used are London rates for January, 1936. The entire book has been rewritten to conform with the Standard Method of Measurement, 1935. It will be noticed that not only are the London and South of England methods dealt with, but the variations due to Midland and Northern methods have been incorporated, particularly as regards brickwork, and considerable additions have been made to the chapter on "Plumbing" due to the 1934 Bye-Laws of the Metropolitan Water Board.

After many years' experience in the profession, the author is aware that it is impossible to prepare a book of this nature without a considerable amount of help, as the knowledge of all trades necessary for such purpose is more than one man can acquire, but having many friends in the building industry, he was fortunate in being able to arrange for at least one expert in each trade to read, criticise, and amend where necessary the different chapters dealing with the various trades. The names appear elsewhere in the list of acknowledgments, but the author finds it impossible to express adequately his indebtedness to the many gentlemen who have so generously helped.

Practical men may consider some of the prices high, but this has been arranged purposely, so that if used by the inexperienced little harm may result; the object being *not*

to give lists of prices but to show the young surveyor how to prepare his own prices and what to avoid.

The contents have been kept up-to-date, and it is believed that many of the subjects have not been treated before, especially Fire-resisting Floors, White and Coloured Cements, Copper Tube Work, Terra-cotta Slabs and Temporary Timber Work. The whole of the information was obtained under post-war conditions in work of good quality.

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CHAPTER I.

INTRODUCTORY; PREPARATORY WORK AND SPECIALIST TRADES

Builders' Estimates.—Bills of Quantities are usually supplied for all except small jobs, and many firms refuse to tender unless Quantities are supplied, but if the job is a small one, or consists principally of alterations, it will be necessary for the Builder to take out Quantities himself. It is impossible to prepare a reliable estimate without a sound knowledge of Quantity Surveying, and it is assumed that the reader has some knowledge of this subject.

Correct estimating is based upon data acquired from actual costs, and if the costs of jobs have been kept accurately and analysed, valuable information for estimating purposes is available. For approximate estimates it is possible to obtain prices by "Cubing" and by "Rough Quantities," but for keen competitive estimates the items in a Bill of Quantities must be properly priced in a scientific manner, using data acquired from experience.

Pricing Data and Analyses.—Pricing data are obtained either from accurate cost-keeping or by observations kept upon work in progress by the foremen or the Estimating Surveyor. The pricing data submitted in this work concern typical items only, as found in a Bill of Quantities, for it is impossible, in a book of this size, to deal with every item. It is the object of the author to instruct the student to prepare data for himself, and it will be found that most of the vital items are dealt with; other prices can be found by analogy.

Nothing has been allowed in any detailed prices for profit, establishment charges, water, or insurance; these matters are described separately.

It will be noticed that to obtain prices per yard super, or per foot super, typical examples are taken of large areas; this is the only safe method.

The Estimating Surveyor.—The work of the Builders' Estimating Surveyor is responsible and varied. He is required to know almost as much of quantity surveying as a Quantity Surveyor; a sound knowledge of construction; the preparation of estimates; and, as his work usually includes the superintendence of building work in progress, as well as supervision and management, his work is arduous and his hours are long. The occupation, however, is interesting and more remunerative than other departments of a builders' business, and moreover, age is no handicap, as experience is an asset. The Author is of opinion that it is good training for a Quantity Surveyor to be in the estimating department of a building firm of standing for a time, and candidates from such offices are now accepted for the Quantity Surveyors' Examination of the Chartered Surveyors' Institution, although they are not admitted to Membership until they are engaged in the profession.

A young man desiring to become an Estimating Surveyor may experience difficulty in obtaining the information he requires, particularly as to pricing data, and he should do all that he possibly can to assist his seniors in compiling prices, for only by assisting can he learn the methods. Unless a senior surveyor can thoroughly trust his junior, and can rely upon loyalty from him, he naturally is loth to give away information that has taken many years of hard work to acquire.

A junior surveyor should master the art of "Quantity Surveying," and prepare scientific data for himself (upon the lines laid down in this book), so that he may become of use to his senior and gain his confidence. Once such confidence has been obtained, and having proved his loyalty, the junior will find the Estimating Surveyor not only willing but anxious to help him. The junior must also remember that he must prove his loyalty to his employers also, for it is not reasonable to expect a substantial firm will allow their prices (often obtained by scientific methods of costing) to become the property of someone who may leave them at any moment to take up a position with a rival firm. Many reputable firms accept articled pupils in their estimating departments, and in such cases it is not difficult for the pupil to obtain data and prices.

The Quantity Surveyor.—The ordinary work of preparing quantities does not come within the scope of this work, but it is well to note that for the Final Examination for Quantity Surveyors, the Chartered Surveyors' Institution now requires

a knowledge of prices; and the new subject, "Analysis of Builders' Prices," was introduced for the first time in 1923. By the courtesy of the Institution, some examples are included in this work. It is necessary for the Quantity Surveyor to understand the preparation of prices for many reasons, but especially when dealing with disputed accounts in which "extras" occur, and for which there is no item in the Bill of Quantities. Again, a client requires an approximate estimate from his architect, who in his turn consults a Quantity Surveyor, and if he can prepare properly analysed prices of some of the most important items in building work, he will be able to submit a more reliable estimate than one found by "Cubing" or other approximate methods. If a Quantity Surveyor has a fair knowledge of the "Analysis of Prices" and their preparation, he appreciates the Builders' difficulties, and in consequence the Bills of Quantities prepared by a surveyor with such knowledge will contain suitable clauses and particulars useful and necessary for compiling prices.

Variation in Builders' Estimates.—This is a subject often commented upon by the non-technical press and the public. Frequently in published lists of tenders, a great difference occurs between the prices submitted. The writer considers the following are the principal reasons for such disparity, viz.: (1) Absence of Bills of Quantities; (2) trade conditions; (3) suitability of firms tendering for the particular class of work; (4) inexperienced estimating; (5) careless mistakes; and (6) "sharp practice." There are other factors which need not be mentioned here.

A contractor in a large way of business remarked to the author some time ago that in the majority of cases the highest and lowest prices in any group of tenders were "mistakes." It is often stated that "the man who makes the biggest mistake usually gets the job." In order that the beginner may appreciate at an early stage the importance of collecting reliable data for himself, we will endeavour to analyse the reasons for the disparity that occurs in tendering.

(1) *Absence of Bills of Quantities.*—As most reputable firms now refuse to tender unless Quantities are supplied, no further comment is necessary, but if Quantities are not supplied there is often a big bill of "extras."

(2) *Trade Conditions.*—A firm with plenty of work in hand will not "cut" the prices, and perhaps will submit an estimate

purposely kept high, so as to make certain of losing the contract rather than inform the architect they are too busy to undertake any more work. If possible, the architect should make a few local enquiries himself regarding the amount of work a firm has in progress. A firm having very few jobs in hand will sometimes be prepared to forgo their profit in order to find work to keep their men employed.

(3) *Suitability of Firms Tendering.*—Some architects, and many public authorities, do not realise the importance of this point. A firm specialising in masonry, and owning a stone-yard, is in a better position to tender for a job in which stone is the constructional material, than a firm not so fortunately placed. A firm specialising in manufactured joinery, possessing up-to-date labour-saving machinery and a well-organised joinery works will have a greater advantage in tendering for work containing a considerable amount of joinery than firms specialising in other trades. Certain firms are accustomed to high class work only, and when invited to tender for work of inferior quality, their prices are higher than those of other firms specialising in cheap work. Invitations to tender should be made with discretion.

(4) *Inexperienced Estimating.*—It sometimes happens that men with capital, but no technical experience, acquire responsible positions in the building industry, and when engaging Estimating Surveyors are inclined to accept men at their own valuation. In consequence, "smart" men with plenty of self-confidence and little technical experience obtain positions. With ordinary work they may successfully retain their posts for a time, but the first job requiring original thought and detailed analysis usually leads to disastrous results. The tenders prepared by such individuals are usually very high or very low. It may happen that owing to illness, or holidays, a junior is called upon to price a Bill of Quantities which he may not quite understand. If he is cautious he will probably price too high, but if he is anxious to obtain the job he will probably take greater risks than the experienced man.

(5) *Careless Mistakes.*—In large establishments where the bulk of the arithmetical work is performed by the "Comptometer," this is not so likely to occur as with smaller firms; but such accidents are not unknown in the offices of the larger contractors. It is very easy for mistakes to occur in pricing, owing to the limited time that is usually allowed for the pre-

paration of an estimate. By the time drawings are prepared for a job the client is usually anxious for the work to commence, and as the Quantity Surveyor frequently has insufficient time for his work, the builder gets even less. An eminent surveyor, lecturing at the Chartered Surveyors' Institution, stated that he considered Builders' Estimating Surveyors to be an overworked section of the community, for he often noticed them pricing Bills of Quantities whilst travelling in railway carriages. As there is so much other work to be done in a builder's office during the day, there is a tendency to leave the preparation of estimates till the evening; in fact, the majority of estimates are prepared after the usual office hours, when those responsible are physically and mentally tired. In such circumstances it is not surprising that mistakes occur. If a reasonable amount of time is given for the preparation of an estimate, the tendering is closer.

(6) "*Sharp Practice.*"—It is not an unusual occurrence for certain firms to submit a very low estimate, often below nett cost, relying upon "extras" for their profit. Sometimes this is successful, and sometimes it is disastrous, especially if the Architect and the Quantity Surveyor have been forewarned. The usual procedure is to ascertain if extra work is likely to occur, and then to "amend" the items in the Bill of Quantities before sending a priced copy to the architects, so that any items likely to be omitted are priced at a very low rate, whilst items which are likely to be used as prices for possible extras repriced a at rates higher than they should be. An Architect and a Quantity Surveyor, having once experienced this form of "sharp practice," do not usually invite such a firm to tender a second time; and respectable building firms condemn this conduct, but the fact remains, there are such "practitioners."

Procedure on Receipt of Bill of Quantities.—Before making any attempt to price a Bill of Quantities, the Estimating Surveyor should read the Preliminary Bill carefully and ascertain—

1. The nature of the site and situation of the job.
2. Transport facilities.
3. Quality of the work.
4. The trade that is predominant.

This latter item is more important than is at first apparent, and, as mentioned earlier in this chapter, certain firms are in

a position to quote a low price for particular trades, owing to the possession of special machinery or workshop facilities.

Upon perusal of the bill, it will frequently be noticed that certain specialist firms are mentioned whose material must be used. These firms should be written at once and quotations obtained, even if a P.C. (Prime Cost) amount be mentioned, as certain firms demand extras which at first are not always apparent.

The next procedure is to obtain quotations for the principal materials (delivered upon the site, if possible), and considerable experience is necessary in finding the most suitable merchants from whom to obtain quotations; principally does this apply to bricks, sand, ballast, carcassing timber, and material for plastering. It is not necessary to obtain quotations for lead, glass, and similar materials, the prices of which are fixed by tariff, and are the same for all firms.

If it is impossible to obtain prices of material delivered to site, it will be necessary to obtain prices for haulage per ton, or per load, and this adaptation of cartage into the prices to be attached to the items in the bill of quantities calls for considerable accuracy. Again, it will be necessary to obtain prices for haulage and removal of excavated material, and frequently this is expensive.

With regard to labour, the trade union rate for the district is ascertained easily from the Trade Journals; but the time to be taken by the men over the different items is the most difficult matter for the Estimating Surveyor to gauge.

Most skilled tradesmen have a labourer or "mate" to attend upon them, but with large jobs it is sometimes possible to arrange for one labourer to attend upon two tradesmen, or perhaps two labourers might attend upon three craftsmen (particularly bricklayers), and this will affect a considerable saving. A datum acquired on work where perhaps one labourer attended upon one bricklayer will naturally give too high a price for work where one labourer will attend upon more than one bricklayer; and a similar state of things occurs with mason's and plasterer's work.

Different men take different time over the same task; the time taken can be influenced by the particular class of work and by the weather; but the reader can easily understand there are many other influences.

From the above remarks it will be seen that it is impossible

to give a list of prices suitable for any district or for any class of work, and that to price Bills of Quantities by the aid of a price book or stock pricing data is unreliable. The prices for each different job in each district must be calculated carefully, and each task considered upon its special conditions.

After perusing the Bill of Quantities and, if possible, inspecting the plans, the Estimating Surveyor should visit the site and ascertain any special conditions and price any "Spot Items." Having seen the site and investigated all local circumstances, the surveyor will be able to visualise the job as he prices the items; but this calls for experience, for it is upon his past experience that the trained Estimating Surveyor gains his knowledge in this direction. The pricing of "Spot Items" is a matter that depends upon the capacity of visualising the job, and upon previous experience, and this matter is explained fully in Chapter III.

The Estimating Surveyor should, of course, keep in touch with current prices, but for jobs of any size it is advisable to obtain prices for the materials specifically, as some prices vary from day to day.

Order of Pricing the Various Trades.—The bills for the different trades are not priced in the same order as sent out by the Quantity Surveyor, but such order will be followed in this work, so that the reader can refer quickly to any particular trade. It is possible to price a considerable number of items, and several trades, before it becomes necessary to visit the site, and occasionally, if carefully prepared plans, as well as quantities are supplied, it may not be necessary to visit the site at all. If the building is constructed principally of brick, naturally the most important trade from a financial point of view will be the "Bricklayer," and this trade should be priced first. Afterwards the "Carpenter" and "Joiner" can be priced, and if these bills are totalled, the trained surveyor will be able to form a rough idea of the final cost of the whole job. The value of the bricklayer's bill is frequently one-third of the total cost of the whole job. It is difficult to price the "Excavator" bill without visiting the site, as there are so many items dependent upon local conditions; certain kinds of soil are more expensive to excavate and cart away than others, and the excavated material may perhaps prove of value; but a very important factor in pricing will be the distance of the nearest "shoot." This will affect the cartage considerably,

for in some towns the only available shoot may be some miles away. It is more convenient to price the Preliminary Bill after the others are complete.

Typical Enquiries to be made Locally.—The following enquiries are usual :—

Situation of the Site.—This should be noted, and if there are no suitable road facilities, it may be necessary to form a temporary road, or if the ground is liable to become water-logged, sleeper tracks may be required.

Nature of Soil and Sub-soil.—As mentioned previously, this is important, for if sand and gravel are found, the material may be used or sold at a profit.

Carting Facilities and Distance of Shoot.—If possible, quotations must be obtained from the local cartage contractors. If the firm tendering have a transport department, then the distance from nearest railway station must be noted, and comparative costs worked out.

Local Labour and Lodgings.—It is necessary also to ascertain if any labour is available locally, or if workmen will have to travel, and to enquire if suitable lodgings are available for foremen and special tradesmen, who will have to be sent from headquarters. It may happen that such difficulty will occur in these circumstances that a contractor may find it advisable not to tender.

Local Fees.—The fees due to the various public authorities must be ascertained, and any special requirements noted. In London there are statutory fees due to District Surveyors which have to be paid by the builder, and in some cases these amount to a considerable sum. The fees demanded by certain Water Authorities are somewhat heavy, and must be calculated as described later.

Local Markets for Materials.—Much work in this direction can be done from the head office, but if the surveyor has time, it is advisable to enquire locally for certain materials ; local cartage contractors can be of considerable assistance in this way.

The above are a few matters that will pay for enquiry, but the trained surveyor will be alert for information always, for what perhaps might appear inconsistent may have a considerable bearing upon the prices. The demolition of a mansion in the neighbourhood may offer a cheap market for second-hand bricks (often better than new ones), and the development of a building estate may provide a cheap " shoot."

Specialist Trades.—There are many items in a bill of quantities which the builder can sub-let with advantage, but there are also many items which he cannot possibly undertake, owing to the fact that specialist craftsmen are required. It is proposed to omit any detailed costs of such items, as builders can always obtain quotations. Students and others who are not in the position to obtain firm prices, will find approximate prices in "Laxton" and other price books.

CHAPTER II.

DATA FOR BASIC ITEMS.

Variation in Rates of Wages.—The rates of wages paid in different districts can be found in the Trade Journals, and the student should find no difficulty in adjusting the costs detailed herein. The rates taken are those of London on January 1st, 1936, which are—Craftsmen, 1s. 8d. per hour, and Labourers, 1s. 3¼d. per hour.

Pricing for Basic Items.—Before it is possible to compile prices for the various items as they appear in a Bill of Quantities, it is necessary to prepare data for items which do not actually appear in the bill, but which are incorporated with other descriptions. Included in these are such materials as Portland cement, lime, lime mortar, cement mortar, timber, and plastering material; but, in addition, the use and waste of scaffolding for bricklayer, mason, and plasterer will have to be calculated. For convenience, fractions have been omitted, and the calculations made to the nearest farthing.

EXCAVATOR AND CONCRETE.

Portland Cement.—Portland cement is sold by the ton, which contains 20 trade bushels; a ton is slightly less than 1 yd. cube. It is sold in "paper" bags (non-returnable) and 1 ton consists of 20 bags. This material, however, is also sold in jute sacks (11 to the ton), and although a charge is made for these, they are credited at the same price. Ordinary sacks are going out of use for cement, but if they are used they are charged at 1s. 9d., and credited at 1s. 6d. In the examples that follow, "paper" bags are assumed.

Detailed Cost per Bushel.—

One ton of Portland cement, delivered to job	£2	0	0
Unloading—2 labourers at ½ hour each equals 1 hour at 1s. 3¼d.	0	1	3¼
Cost per ton	£2	1	3¼

Dividing by 20 gives the price per bushel of 2s. 0¾d.

Detailed Cost per Foot Cube.—The weight of Portland cement (and other similar materials) compared with the space it occupies depends upon whether it is loosely or tightly packed, the official basis is 90 lbs. per cubic foot, therefore 1 yd. cube (i.e. 27 cub. ft.) equals almost 21·7 cwts. Calculations are often made on the basis of 1 ton of cement being equal to 1 yd. cube, but this method is not strictly accurate although it serves for rough calculations. To obtain the price per yard cube the price per ton of £2 1s. 3¼d. is taken from the last example, then by ordinary arithmetic it will be found that the price per yard cube is £2 4s. 9½d. Dividing by 27 gives the price per foot cube of (say) 1s. 8d.

Lias Lime.—Lias lime is usually sold by the ton, but in some districts by the yard cube. The remarks as to weight and bulk given in the last example apply to lime in a much greater degree, for this material varies considerably in different districts. Lump lime varies from about 45 lbs. to 60 lbs. per foot cube, but ground lime averages 30 bushels to the ton, or about 39 cub. ft.

Detailed Cost per Foot Cube and per Bushel.—

One ton of Lias lime delivered to job	£1	17	0
Unloading—2 labourers (as in last item)	0	1	3¼
Use of sacks, say 11 at 3d.	0	2	9
Cost per ton	£2	1	0¼

Dividing by 39 gives the price per foot cube of 1s. 0¾d.
Dividing by 30 gives the price per bushel of 1s. 4½d.

Grey Stone Lime.—This lime as a rule is sold by the ton, which will yield about 40 bushels, or 2 cubic yards. Local enquiries should be made about lime as there is much variation in bulk and in the number of sacks required.

Detailed Cost per Foot Cube and per Bushel.—

	£	s.	d.
One ton of grey stone lime delivered to job	£2	2	0
Unloading—2 labourers, ½ hour each at 1s. 3½d.	0	1	3½
Use of sacks, say	0	2	9
	£2	6	0¼

Dividing by 52 gives the price per foot cube of 10¾d.
Dividing by 40 gives the price per bushel of 1s. 1¾d.

BRICKLAYER.

Scaffolding.—The cost of the timber must be spread over a number of jobs, and if we take 5 per cent. of the total cost for each job, we are assuming that the plant will be worn out after the twentieth job; this is a fair average.

As a typical example, assume a wall 49½ ft. by 49½ ft. in area, and 1½ bricks thick, i.e. 9 rods super. Standards are assumed at 8 ft. apart :—

	£	s.	d.
66 poles, each 28 ft., at 3s. 6d. each	£11	11	0
15 poles, each 20 ft., at 1s. 9d.	1	6	3
60 putlogs, at 9d. each	2	5	0
120 boards, 12 ft. long, at 2s. 6d. each	15	0	0
200 wire lashes, at 9½d. each	7	18	4
	£38	0	7

Taking 5 per cent. of this as loss for depreciation, we obtain a price of £1 18s. for 9 rods. This shows the method, but the student is recommended to measure an actual scaffold in use.

Detailed Cost per Rod Super (1½ bricks thick), assuming 9 rods super :—

	£	s.	d.
Use and waste of material, as last item	£1	18	0
3 labourers : 44 hours, at 3s. 9¾d. per hour—loading, unloading, erecting, and striking	8	7	9
	£10	5	9

Dividing this total by 9 gives the price per rod of £1 2s. 10d. To this must be added cartage, which depends entirely upon the distance, and as this will be quoted by weight, it should be noted that per rod the scaffold will weigh about 15 cwts.

Detailed Cost per Yard Super (1 brick thick).—A standard rod contains 272 ft. super of brickwork, 1½ bricks thick (which

is equivalent to 408 ft. super of 9 in. work), but in certain parts of the country, brickwork is reduced to a standard yard, one brick thick. A standard rod contains 45⅓ yds. super of 9 ins. work (i.e. 408 ft. divided by 9); therefore, dividing the previous total by 45⅓ gives the price per yard super "reduced" of 6d. (approximately). To this the cost of cartage must be added.

In the calculations no allowance has been made for ladders, as it is presumed that the builder will allow for these in his percentage for overhead charges. A "scaffolder" is usually paid ½d. or 1d. per hour above labourers' rate.

Loading and Unloading Scaffold.—Many builders ignore this, but with cut jobs it must be considered. A fair allowance for loading and unloading is one labourer five hours per rod.

Tubular Metal Scaffolding.—This method of scaffolding is now used extensively for large buildings. Its first cost is more than limber scaffolding, but renewals are not so frequent. Many firms hire metal scaffolding, and the price for a job consisting of about 200 rods of reduced 14 in. brickwork, for a period of six months, works out at £3 per rod of brickwork, which price includes all boards, ladders, guards, wheels, and fall ropes, and all erection, dismantling, and normal transport. The price per yard super for 9 in. reduced brickwork works out at 1s. 4d.

MORTARS.

In calculating the cost of either lime or cement mortar, it must be kept in mind the materials used diminish in bulk when mixed with water and graded together. The proportions in which the materials are mixed affects the price per yard considerably; a usual proportion is one part of lime or cement to three parts of sand (usually written 1 to 3), but for engineering work the proportions may be 1 to 2, or perhaps 1 to 1. In the following prices nothing has been allowed for water, this is calculated later, but it must be remembered in certain circumstances it may be advisable to add the cost of the water to each item.

The reduction which takes place on mixing is explained by experiments made by Dr. J. Leask Manson in his work on "Experimental Building Science" (see Chapter IV., "Excavator and Concrete"). A mortar 1 to 1 will show approximately a reduction of one-sixth; 2 to 1, a reduction of one-fifth, and

3 to 1, a reduction of one-fourth. In the following detailed costs an addition has been made in each case to counteract such reduction. For example, if the bulk is reduced by 25 per cent., then 33⅓ per cent. must be added, and if the bulk is reduced by 20 per cent., then 25 per cent. must be added, and so on.

Detailed Costs per Yard Cube for Cement Mortar and Lime Mortar.—

CEMENT MORTAR (1 TO 3).

	£ s. d.
1 yd. cube Portland cement, at £2 1s. 2d. per ton	£2 4 9½
3 yds. cube sand, at 8s. 6d.	1 5 6
Add 33⅓ per cent. for reduction in bulk	£3 10 3½ 1 3 5
Total for 4 yds.	£4 13 8
Take one-fourth	£1 3 5
Labour, mixing—12 hours at 1s. 3½d.	0 15 3
Price per yard cube	£1 18 8

CEMENT MORTAR (1 TO 2).

	£ s. d.
1 yd. cube Portland cement, at £2 1s. 2d. per ton	£2 4 9½
2 yds. cube sand, at 8s. 6d.	0 17 0
Add 25 per cent. for reduction in bulk	£3 1 9½ 0 15 5½
Total for 3 yds.	£3 17 2¾
Take one-third (say)	£1 5 9
Labour, mixing (as before)	0 15 3
Price per yard cube	£2

CEMENT MORTAR (1 TO 1).

	£ s. d.
1 yd. cube Portland cement, at £2 1s. 2d. per ton	£2 4 9½
1 yd. cube sand, at 8s. 6d.	0 8 6
Add 20 per cent. for reduction in bulk	£2 13 3½ 0 10 8
Total for 2 yds.	£3 3 11½
Take one-half	£1 11 11
Labour, mixing (as before)	0 15 3
Price per yard cube	£2 7

LIME MORTAR (1 TO 3).

	£	s.	d.
1 yd. cube, i.e. 27 ft. cube, grey stone lime, at 10¾d.	1	4	2
3 yds. cube sand, at 8s. 6d.	1	5	6
	£2	9	8
Add 33⅓ per cent. for decrease in bulk	0	16	7
Total for 4 yds.	£3	6	3
Take one-fourth	£0	16	7
Labour, mixing—8 hours at 1s. 3½d.	0	10	2
Price per yard cube	£1	6	9

LIME MORTAR (1 TO 2).

	£	s.	d.
1 yd. cube, i.e. 27 ft. cube, lime, at 10¾d.	£1	4	2
2 yds. cube sand, at 8s. 6d.	0	17	0
	£2	1	2
Add 25 per cent. for decrease in bulk	0	10	3½
Total for 3 yds.	£2	11	5½
Take one-third	£0	17	2
Labour, mixing (as before)	0	10	2
Price per yard cube	£1	7	4

LIME MORTAR (1 TO 1).

	£	s.	d.
1 yd. cube, i.e. 27 ft. cube, lime, at 10¾d.	£1	4	2
1 yd. cube sand at 8s. 6d.	0	8	6
	£1	12	8
Add 20 per cent. for decrease in bulk	0	6	6
	£1	19	2
Take one-half	£0	19	7
Labour, mixing (as before)	0	10	2
Price per yard cube	£1	9	9

"Snowcrete" Cement Mortar.—This is frequently required for pointing, to obtain a very white joint. If ordinary Portland cement costs £2 per ton, then "Snowcrete" will cost about £8 15s. per ton. This material is supplied in paper bags which are not returnable. It is very important that a white sand be used, otherwise the joints will not dry out white.

Detailed Cost per Yard Cube.—

"SNOWCRETE" CEMENT MORTAR (1 TO 3).

	£	s.	d.
1 yd. cube "Snowcrete," at £8 16s. 2d. per ton .	£9	11	2
3 yds. cube sharp white sand, at 12s. 6d. . .	1	17	6
	£11	8	8
Add 33⅓ per cent. for reduction in bulk	3	16	2
Cost for 4 yds. . . .	£15	4	10
Take one-fourth	£3	16	2½
Labour, mixing—12 hours at 1s. 3½d. .	0	15	3
Price per yard cube . .	£4	11	5½

It will be noticed that in all the preceding analyses, the labour has been taken as 12 hours for Portland cement and 8 hours for lime.

Mixing by machinery is described in Chapter XVI.

Waterproofed Cement Mortar.—If the mortar is required to be waterproofed as described later for concrete, the proportion of "Pudlo" brand waterproofer will be 3 per cent. by weight for a mix of 3 to 1, and 5 per cent. by weight for a mix of 2 to 1.

The 3 per cent. by weight equals 7½ per cent. by bulk, and the 5 per cent. by weight equals 12½ per cent. by bulk to the bulk of the cement.

One yard cube of mortar (1 to 3) requires 24½ lbs. of waterproofer and one yard cube of mortar (1 to 2) requires 52 lbs.

As described later, the material costs 11¼d. per lb., and the proportions are therefore $3 : 1 : \frac{1}{13}$ (approximately) and $2 : 1 : \frac{1}{8}$ respectively.

Detailed Costs.—

CEMENT MORTAR (1 TO 3) WITH 3 PER CENT. "PUDLO."

	£	s.	d.
4 yds. cube of materials for cement mortar as before described	£4	13	8
98 lbs. "Pudlo," at 11¼d.	4	11	10½
	£9	5	6½
Divide by $4\frac{1}{13}$	£2	5	7½
Add for mixing—12 hours at 1s. 3½d.	0	15	3
Price per yard cube .	£3	0	10½

CEMENT MORTAR (1 TO 2) WITH 5 PER CENT. "PUDLO."

3 yds. cube of materials for cement mortar as before	£3	17	2¾
156 lbs. "Pudlo," at 11¼d.	7	6	3
	£11	3	5¾
Divide by 3⅜	£3	11	6
Add for mixing—12 hours at 1s. 3¼d.	0	15	3
Price per yard cube .	£4	6	9

Mill (or "Pan") Mortar.—The above prices have been calculated upon hand mixing, but for machine-made mortar the datum can be found only by keeping accurate costs, and the price depends upon the size of the plant, its power, and consequent output. The working costs for a typical week should be kept, and the output ascertained, and due allowance made for depreciation. A typical plant costing slightly less than £10 per week to run effected a saving on hand labour of 7s. to 15s. per yard (see Chapter XVI.). With petrol engines and modern plant better results than this can be obtained. Mortar can be purchased ready mixed at about 15s. per yard cube; occasionally quotations are given per ton, which equals 18 ft. cube.

MASON.

Scaffolding.—A mason's scaffold will require twice as much timber as a bricklayer's scaffold, and the labour of erecting and striking will take twice as long. Therefore, taking our former price per rod of £1 2s. 10d. and doubling it, we obtain £2 5s. 8d. for an area of 272 ft. super, and as ashlar work in masonry is priced by the foot super, dividing by 272 we obtain the price per foot super of 2d. (approximately). This is a rough method for comparative purposes; the scaffold should be worked out in detail, as described for "Bricklayer."

Mortar.—The mortar for stone work is often specified to be: "Good lime mortar, composed of one part of fresh, well burnt, grey stone lime and one part of stone dust well mixed and used fresh."

Detailed Cost per Yard Cube.—

1 yd. cube of grey stone lime, 27 ft. cube, at 10¾d.	£1	4	2
1 yd. cube of stone dust, at 10s.	0	10	0
	£1	14	2
Add 20 per cent. for reduction in bulk . . .	0	6	10
Total for 2 yds.	£2	1	0
Take one-half	£1	0	6
Labour, mixing—8 hours at 1s. 3¼ . . .	0	10	2
Price per yard cube . . .	£1	10	8

DRAINLAYER.

"Neat" Cement (for jointing pipes).—The joints of stoneware pipes are often specified to be in "neat" cement, i.e. without the addition of sand. According to Dr. Leask Manson, Portland cement mixed with water decreases in bulk by 15 per cent., so that it is necessary to add 17·65 per cent. to cover this.

Detailed Cost per Yard Cube ("Neat" Cement).—

1 yd. cube of Portland cement, at £2 1s. 3d. per ton	£2	4	9½
Add for decrease in bulk, say 17½ per cent. . .	0	7	10
	£2	12	7½

Dividing by 27 gives the price per foot cube of 1s. 11½d.

Nothing is added in this case for labour, as the material will be prepared in small quantities, when and as required, by the labourer attending upon the bricklayer jointing the pipes.

WATERPROOFED CEMENT AND SAND JOINT (1 TO 2).

The use of a material such as "Pudlo brand waterproofer" enables sand to be used for jointing. The price for the 1 to 2 cement mortar given in this Chapter earlier works out at £2 1s. per yard cube; 1 yard cube of this mix requires 52 lbs. of "Pudlo" at 11¼d., i.e. £2 8s. 9d., but this will necessitate less sand to the extent of about 1 ft. cube (worth 4d.). Therefore the total cost per yard cube amounts to £4 9s. 5d.

CARPENTER.

Timber: How Purchased.—The ordinary timber used for construction is known as "fir" technically, but actually it

may be either pine or spruce. It is sold by the "Standard" of 165 ft. cube, formerly known as the "St. Petersburg" (now Leningrad) Standard, but there are other standards. Originally a "Standard" consisted of Quarters and "Deals," and a "Deal" is a 6-ft. length of 11 × 3. A quarter consisted of 30 deals, so that 120 deals made one standard, but it is now usual for decimal parts of a standard to be used instead. Timber of all dimensions is reduced to this "standard" of 165 ft. cube. Knowing the price per standard, it is a simple matter to divide by 165 to find the price per foot cube. Frequently timber is classified as follows :—

Planks = 11 ins. wide.
Deals = 9 „ „
Battens = 7 „ „

Timber : Conversion to Useful Sizes.—If a firm is in a large way of business, it is less expensive to purchase timber of large scantlings and "convert" by sawing into useful sizes, especially if a saw-mill and power is available ; or, again, it might be less expensive, even if power is not available, to send the bulk timber to a saw-mill.

The saw-mill charges vary considerably in different parts of the country, but the terms "flat cut" and "deep cut" are usual, and need no explanation. As a general rule, the saw-mill charges are the same for one cut as for two, three, and four cuts, but for every cut above four, 25 per cent. is usually added. As a rough guide to pricing, it will be found that the cost of cartage and converting bulk timber to useful sizes adds from 1s. to 1s. 6d. per foot cube. If over four cuts, add 25 per cent. per cut, and for hardwoods add 12½ per cent. To the charges for sawing, the labour loading and unloading, the cost of carting to and from the saw-mill, and the stacking must be added.

Timber : Usual Imported Scantlings.—If timber of the specified dimensions is available, it will be less expensive to purchase the same in bulk, delivered direct to the job, but it must be remembered that the price per "standard" does not vary in direct proportion to the number of cubic feet therein contained. The law of supply and demand is the principal factor in the variation of prices. Architects, for the purpose of economy, always should specify timber of the usual imported sizes where possible, and builders, before tendering, should ascertain the

scantlings specified before pricing at a rate per foot cube. In a carefully prepared Bill of Quantities the Quantity Surveyor would describe the different scantlings in the various items.

The following list of prices is for comparative purposes, and shows the variation that occurs with the different imported sizes, viz. :—

Size.	Price per Standard, delivered.			Per foot cube.	
Ins.	£	s.	d.	s.	d.
2 × 11	20	0	0	2	5
3 × 4	18	0	0	2	2¼
3 × 9	20	0	0	2	5
3 × 11	20	0	0	2	5
4 × 9	23	0	0	2	9½
4 × 11	24	0	0	2	11

The above approximate prices will be referred to later, but for actual jobs quotations should be obtained from the timber merchants, as the prices vary week by week. Sometimes it is cheaper to use a larger sized timber than that specified. Builders can effect great economy by purchasing timber in bulk. Sales are advertised in the "Timber Trades Journal."

Cartage and Unloading.—These items are very important, and may add considerably to the price of the timber; a price should be obtained for cartage before tendering, if it be impossible to obtain a quotation for the material delivered. Quotations for haulage or cartage are usually per ton, but this is not the usual "ton" of commerce, but is computed at the rate of 50 cub. ft. to the ton, and for hardwoods, usually 40 ft. is taken. The cartage contractor or the timber merchant usually loads, but provision must be made by the builder for unloading.

If the builder keeps a stock of timber at his own yard, then the cost of loading, as well as unloading, must be added to the cartage, but this extra cost will be more than covered by the saving effected through purchasing the timber in bulk.

Assuming that two labourers unload, the following should be allowed per standard: 3″ × 4″, 1 hour each; 2″ × 11″, 3″ × 9″, 3″ × 11″, and 4″ × 9″, 1½ hour each. For 4″ × 11″ allow 2 hours for two men.

Planing and Sawing.—Estimating Surveyors find it necessary to prepare tables giving prices of the various timbers

used, and the following are suggested. Variations must be made to suit local circumstances and individual needs. Table No. I. gives the various scantlings as imported and the average present-day prices, and the cost of delivery has been taken at £2 per standard; the quotations for carting will be at a price per computed ton.

TIMBER TABLE No. I.

Imported Scantlings.	Price per Standard 165 ft. cube.	Price per Standard delivered (£2 added).	Price per foot cube rough.	Price per Standard planed £4 added).	Price per foot cube wrought
ins.	£	£	s. d.	£	s. d.
4 × 11	24	26	3 2	30	3 7¾
4 × 9	23	25	3 0½	29	3 6¼
4 × 8	22	24	2 11	28	3 5
4 × 7	20	22	2 8	26	3 2
3 × 11	20	22	2 8	26	3 2
3 × 9	20	22	2 8	26	3 2
3 × 8	18	20	2 5	24	2 11
3 × 7	19	21	2 6	25	3 0½
3 × 6	19	21	2 6	25	3 0½
3 × 4½	18	20	2 5	24	2 11
3 × 4	18	20	2 5	24	2 11
2½ × 9	20	22	2 8	26	3 2
2½ × 7	19	21	2 6	25	3 0½
2 × 11	20	22	2 8	26	3 2

The cost of planing the imported scantlings has been taken at £4 per standard, but actually the quotations from the saw-mills will be per square of 100 ft. super, or per computed ton.

Table No. II. shows four typical examples of imported scantlings (taken from Table No. I.). The cost of converting into the various useful sizes required has been taken at £5 per standard, and the cost of planing at £8 per standard; but the surveyor must obtain local quotations or actual costs from the saw-mill and shops. In Table No. I. it will be found that the average price per foot cube is 3s. 2d. for planed timber.

Waste.—A certain amount of waste occurs in planing, this is explained later in "Joiner."

Prices Per Foot Run, or Per Foot Super.—It is often necessary with carpenter's or joiner's work to obtain the price per foot run for certain items, and with joinery work often it is necessary to obtain the price per foot super. If the following instructions are followed, it will be a simple matter

TIMBER TABLE No. II.

Imported Scantlings.	Converted Scantlings.	Price per Standard delivered.	Price per Standard sawn (£5 added).	Price per foot cube rough	Price per Standard planed (£8 added).	Price per foot cube wrought.
		£	£	s. d.		s. d.
4 × 9	2 × 9 1 × 9 4 × 4½ 2 × 4½	25	30	3 7¼	38	4 7½
3 × 8	1 × 8 1½ × 8 1½ × 4 2 × 8		25	3 0½	33	4 0
3 × 7	3 × 3½ 2 × 7 1½ × 3½ 1 × 7		26	3 2	34	4 1½
2 × 11	2 × 5½ 1 × 5½ 1 × 11		27	3 3½	35	4 3

to price timber of any dimensions without the aid of a table or ready reckoner. Having found the price per foot cube (by dividing the Standard price by 165), it is obvious that if we divide the cube price by 12, we know the price per foot super for timber 1 in. thick. Therefore we obtain the following rule: To obtain the price per foot super "as inch," call the shillings in the cube price pence, and the parts of shillings, parts of pence. The prices per foot super for timber of ½ in., 2 ins., or any other thickness can then be found by proportion.

Having found the price per foot super, it is not difficult to obtain the price per foot run. For example, assume timber at 5s. per foot cube, and presuming we wish to know the price per foot run of 6″ × 2″, we proceed as follows: Five shillings per foot cube becomes five pence per foot super "as inch," and (as 6 ins. is half of a foot) a foot run of 6″ × 1″ would be 2½d., i.e. half of 5d. As 2 ins. is twice 1 in., a foot run of 6″ × 2″ is twice 2½d., or 5d. This method is very useful in pricing prepared timber for joinery work.

Alternative Method.—There is another method of finding the price per foot run direct from the price per foot cube, which is often performed mentally by practical men. It is

worked upon a basic price of 12s. per foot cube, for at this price every square inch of the sectional area of any scantling is equal to one penny per foot run. If, for example, the price per foot run of 4″ × 3″ at 4s. 6d. per foot cube is required, we proceed as follows: The sectional area of 4″ × 3″ is 12 sq. in., therefore at 12s. per foot cube the price per foot run of 4″ × 3″ is twelve pence. This is obtained by calling the number of square inches pence. As the price of 4s. 6d. per foot cube is three-eighths of 12s., the price per foot run of 4″ × 3″ at 4s. 6d. will be three-eighths of twelve pence, i.e. 4½d. At 5s. per foot cube the price per foot run of 9″ × 1″ will be 3¾d., for the sectional area of 9″ × 1″ is 9 sq. in.; 5s. being five-twelfths of 12s., 3¾d. is five-twelfths of 9d.

PLASTERER.

Scaffolding.—The cost of scaffolding for interior plasterers' work is not priced separately, but must be included in the prices per yard super for the items "Lath, plaster, float, and set ceilings," or "Render, float, and set walls," or similar plasterers' items. The cost of scaffolding for exterior work is found in a similar manner as described for brickwork. For the purpose of preparing detailed costs for scaffolding for ceilings and for walls, assume a room 20′ × 20′, which gives an area of about 45 yds. super for the ceiling.

Detailed Cost per Yard Super (for Ceilings).—

	£	s.	d.
15 8-ft. poles, at 1od.	0	12	6
25 10-ft. poles, at 1s.	1	5	0
18 12-ft. boards, at 2s. 6d.	2	5	0
18 6-ft. boards, at 1s 6d.	1	7	0
40 wire lashes, at 9½d.	1	11	8
Total cost	£7	1	2
Use and waste, 5 per cent. of above total	£0	7	1
Erecting and striking—2 labourers, 5 hours, at 2s. 6½d.	0	12	8½
Cost for room	£0	19	9½

Dividing this total by 45 gives the price per yard super of 5¼d. The same scaffold should be available for the cornice. Therefore, when pricing the cornice item, there should be no need to add anything for use and waste of scaffold.

Detailed Cost per Yard Super (for Walls).—

	£	s.	d.
4 pairs of 8-ft. trestles, at 18s. 6d.	£3	14	0
6 12-ft. boards, at 2s. 6d.	0	15	0
Total cost	£4	9	0
Use and waste, 5 per cent. of the above total	£0	4	5½
Allow for 2 labourers attending and moving, 3 hours, at 2s. 6½d.	0	7	7½
Total cost of the room	£0	12	1

If the room is 9 ft. in height there will be 80 yds. super in the walls, and dividing the above total by 80 the price per yard super of 2d. (approximately) is obtained.

Small rooms naturally will cost less than the above, and large surfaces in some cases will require scaffolding as elaborate as that required by the bricklayer. The cost of transport of scaffold must be borne in mind, but as this charge depends upon the total amount of plant required as well as distance, nothing has been allowed for transport in the above price.

The method (originally introduced in the first edition of this work) of finding the price per yard cube and afterwards finding the different thicknesses by proportion has proved so popular that many additional items are now introduced herein.

Chalk Lime.—This lime is sold by the ton, which may yield about 2 cub. yds. (or about 30 bushels), and its price is about the same as that of grey stone lime, i.e. 10⅜d. per foot cube, or 1s. 1¾d. per bushel (see previous item in "Bricklayer").

Plasterers' "Putty."—This material is simply pure lime, slaked or dissolved in water, passed through a fine sieve and then kept for a considerable period until the surplus water evaporates. Dr. Leask Manson, in his "Experimental Building Science," estimates the increase in bulk from 150 to 200 per cent., but for the purpose of analysis, 150 per cent. will be assumed. Plasterers' "putty" is of the consistency of thick cream and is used as a final coat, i.e. "setting coat."

Detailed Cost per Yard Cube.—

	£	s.	d.
11 ft. cube of unslaked lime, at 10½d. per foot cube	£0	9	10½
2 labourers "running" the material—3 hours, at 2s. 6½d.	0	7	7½
Cost per yard cube	£0	17	6

"Coarse Stuff."—This is used as a first coat (or "rendering" coat). It is mixed some time in advance and allowed to

"temper" before it is used. It consists of slaked lime and sand, and the usual proportion is one part of lime to three parts of sand, and one pound of cow hair is added to every 3 ft. cube of mortar. As unslaked lime costs 10¾d. per foot cube, the price of 4¼d. will be assumed for slaked lime (i.e. two-fifths of 10¾d.) The material will decrease in bulk when mixed to the extent of about 25 per cent., which means an addition of 33⅓ per cent. to the analysis.

Detailed Cost per Yard Cube.—

	£	s	d
1 yd. cube of lime (slaked), i.e. 27 ft. cube, at 4¼d.	0	9	6¾
3 yds. cube of washed sand, at 8s. 6d. . .	1	5	6
	£1	15	0¾
Add for decrease in bulk, 33⅓ per cent. .	0	11	8
	£2	6	8¾
Take one-quarter	£0	11	8
Add for cow hair, 9 lbs. at 5d. . . .	0	3	9
Preparation—2 labourers, 2 hours, at 2s. 6½d.	0	5	1
Price per yard cube	£1	10	6

"Fine Stuff."—This material is for the finishing (or "setting") coat; it is prepared as the work proceeds and is composed of plasterers' "putty" and fine sand. The usual proportion is one part of "putty" to two parts of sand.

The material will decrease in bulk to the extent of about 25 per cent., or an addition of 33⅓ per cent.

Detailed Cost per Yard Cube.—

	£	s	d
1 yd. cube plasterers' "putty," at 17s. 6d. .	0	17	6
2 yds. cube fine washed sand, at 10s. . .	1	0	0
	£1	17	6
Add for decrease in bulk, 33⅓ per cent. .	0	12	6
Total for 3 yds.	£2	10	0
Take one-third	£0	16	8
Preparation—2 labourers, 3 hours, at 2s. 6½d.	0	7	7½
Price per yard cube	£1	4	3½

"Gauged Stuff."—This material is used for plastering when it is desirable for the work to set quickly. It consist of "coarse stuff" and "putty" for undercoats, and may consist also of "fine stuff" and plaster of Paris. For flat surfaces a proportion of one part of "putty" to four parts of "coarse

stuff" is not unusual for undercoats; but for "setting" coats a proportion of one part of "putty" to three parts of "fine stuff" will be assumed. In the latter case, plaster of Paris is sometimes used instead of "putty," but as plaster of Paris must be used very fresh and increases so very much in bulk in the process of mixing, it is often more convenient to use "putty." "Gauged stuff" will decrease in bulk during the various operations by about 12½ per cent., so that 16⅔ per cent. must be added for this.

Detailed Cost per Yard Cube ("Coarse Stuff" and "Putty").

	£	s.	d.
1 yd. cube of plasterers' "putty" as before	0	17	6
4 yds. cube of "coarse stuff," at £1 os. 2¼d.	4	0	9
	£4	18	3
Add for decrease in bulk, 16⅔ per cent.	0	16	4½
Total for 5 yds.	£5	14	7½
Take one-fifth	£1	2	11
Mixing—2 labourers, 1 hour, at 2s. 6½d.	0	2	6½
Price per yard cube	£1	5	5½

Detailed Cost per Yard Cube ("Fine Stuff" and "Putty").

	£	s.	d.
1 yd. cube of plasterers' "putty" as before	0	17	6
3 yds. cube of "fine stuff," at £1 4s. 3½d.	3	12	10½
	£4	10	4½
Add for decrease in bulk, 16⅔ per cent.	0	15	0¾
	£5	5	5¼
Take one-fourth	£1	6	4½
Mixing—2 labourers, 1 hour, at 2s. 6½d.	0	2	6½
Price per yard cube	£1	8	10¾

"Fine" Plaster.—This term is used to describe the material for cornices and other mouldings, and a common practice is to mix plaster of Paris and plasterers' "putty" in equal proportions. Plaster of Paris increases in bulk when mixed with water to about the same extent as unslaked lime, i.e. about 150 to 200 per cent. For castings, also detached members of cornices and enrichments, plaster of Paris is used pure in most cases. There are three qualities, "coarse," "fine," and superfine, and the coarse is most suitable for running mouldings; the more expensive qualities are suitable for enrichments only. The material is usually sold by the ton,

which contains about 30 bushels, or about 37 ft. cube. The present price is £3 per ton, including sacks, which works out at 1s. 7½d. per foot cube, and for the purpose of an analysis, ½d. will be added for labour unloading the material, making a total of 1s. 8d.

Detailed Cost per Yard Cube (Plaster of Paris and "Putty").—

	£	s.	d.
1 yd. cube of plasterers' "putty" as before .	0	17	6
11 ft. cube of coarse plaster of Paris, at 1s. 8d.	0	18	4
	£1	15	10
Add for loss in bulk during use, 12½ per cent.	0	4	5½
Total for 2 yds.	£2	0	3½
Total per yard cube . . .	1	0	2

The mixing will take place whilst the material is being used, so nothing is added here for labour.

A loss takes place during use, and 11 ft. cube of plaster of Paris will increase in bulk to 27 ft. cube; no further adjustment is necessary.

Detailed Cost per Yard Cube (Plaster of Paris).-

	£	s.	d.
11 ft. cube of plaster of Paris, at 1s. 8d.	0	18	4
Add for loss during use, 12½ per cent. .	0	2	3½
Price per yard cube . .	£1	0	7½

"Snowcrete" and "Cullamix" Rendering.—The manufacturers of "Snowcrete" now supply a "Snowcrete" mixture which consists of "Snowcrete" cement and a scientifically graded white sand mixed ready for use. This material is also supplied in colours, and is then known as "Cullamix." The makers recommend an undercoat (or two undercoats in three-coat work) of "Water-repellent" cement. The materials are supplied in paper bags which are free. "Water-repellent" cement costs 30s. per ton above the price of ordinary Portland cement, and this at present gives a price (based upon previous datum) of £3 11s. 3d. The weight is about the same as ordinary cement.

The "Snowcrete" or "Cullamix" mixture varies in price from £4 10s. to £7 per ton, but the white "Snowcrete" is £5 per ton.

"Water-repellent" Cement and Sand (1 to 3).—

Detailed Cost per Yard Cube of Material.—

1 yd. cube of "Water-repellent" cement, at £3 11s. 3d. per ton on job	£3	17	9
3 yds. cube of graded washed sand, at 8s. 3d.	1	4	9
	£5	2	6
Materials will decrease in bulk by 25 per cent. so an addition of 33⅓ per cent. must be made	1	14	2
Total for 4 yds.	£6	16	8
Take one-fourth	£1	14	2
Add labour, mixing—12 hours, at 1s. 3½d.	0	15	3
Price per yard cube	£2	9	5

"Snowcrete" Rendering.—

Detailed Cost per Yard Cube.—

Taking the cost of material as £5 per ton and adding for unloading (as in former items), the price of £5 1s. 3½d. is obtained. One ton equals 28¼ cub. ft., and when mixed with water is reduced by approximately 20 per cent., which means that 1 ton will produce when mixed a net volume of 22·60 ft. cube. For the purpose of finding the cost of 27 ft. (or 1 yd.) cube it is necessary to add therefore 20 per cent. to the cost or ⅕, viz. :—

1 ton "Snowcrete" mixture	£5	1	3
Add for decrease in bulk and for extra material for 1 yd. cube, 20 per cent.	1	0	3
	£6	1	6
Add for labour, preparing, 3 hours, at 1s. 3½d.	0	3	9¾
Cost per yard cube	£6	5	3¾

"Sirapite" Plaster.—This material is now so well known that little explanation is necessary. It is one of the best-known forms of "hard" plaster. Two coats only are required, except on metal lathing when three coats are desirable. There are two qualities, "coarse" and "finish." The following proportions are recommended by the manufacturers (The Gypsum Mines Ltd., Mountfield, Sussex), viz. :—

First coat on walls	One part of "coarse" Sirapite to two or three parts of sand.
First coat on wooden laths	One part of "coarse" Sirapite to one part of sand, with hair added.
Finishing coat.	"Finish" Sirapite should be used, mixed in a pail and prepared neat.
First and second coats on metal lathing	One part of "coarse" Sirapite to three parts of lime and hair (i.e. "coarse" stuff).

The manufacturers recommend a similar mixture (1 to 3) for work on old stone walls and on plaster slabs, and a mixture of 1 to 4 where walls are uneven and plaster has to be thick. Further particulars can be obtained from the makers. On expanded metal lathing a "pricking up" coat of Portland cement and sand is often used (see previous analysis). "Sirapite" is sold by the ton, consisting of 10 sacks, for which a charge of 3d. is made. One ton of "Sirapite" at 82 lbs. per bushel yields 27·317 bushels, or 35·07 cub. ft. For convenience, these figures will be taken as 27⅓ bushels and 35 cub. ft. respectively. The reduction in bulk in mixing is equal to the ratios given for Portland cement.

Detailed Cost per Bushel and per Foot Cube ("Coarse" Sirapite).—

1 ton "coarse" Sirapite delivered	£3	10	0
Use and waste of 10 sacks, at 3d.	0	2	6
Unloading—2 labourers at ½ hour each equals 1 hour, at 1s. 3½d.	0	1	3½
Cost per ton	£3	13	9½

Dividing by 27⅓ gives price per bushel of (say) 2s. 8½d.
Dividing by 35 gives the price per foot cube of (say) 2s. 1½d.

Detailed Cost per Bushel and per Foot Cube ("Finish" Sirapite).—

1 ton "finish" Sirapite delivered	£3	18	0
Use and waste of 10 sacks, at 3d.	0	2	6
Unloading—2 labourers at ½ hour each equals 1 hour, at 1s. 3½d.	0	1	3½
Cost per ton	£4	1	9½

Dividing by 27⅓ gives the price per bushel of (say) 3s.
Dividing by 35 gives the price per foot cube of (say) 2s. 4d.

Detailed Cost of Materials for First Coat on Walls per Yard Cube (i.e. 1 to 3).—

	£	s.	d.
1 yd. or 27 ft. cube "coarse" Siparite, at 2s. 1½d.	2	17	4½
3 yds. cube of washed sand, at 8s. 6d.	1	5	6
	4	2	10½
Add 33⅓ per cent. for reduction in bulk	1	7	7½
Total for 4 yds. cube	5	10	6
Take one-fourth	1	7	7½
Labour, preparing—12 hours, at 1s. 3¼d.	0	15	3
Cost per yard cube	2	2	10½

Detailed Cost of Material for First Coat on Wood-Laths per Yard Cube (i.e. 1 to 1).—

	£	s.	d.
1 yd. or 27 ft. cube "coarse" Sirapite, at 2s. 1½d.	2	17	4½
1 yd. cube of washed sand, at 8s. 6d.	0	8	6
	3	5	10½
Add 20 per cent. for reduction in bulk	0	13	2
Total for 2 yds. cube	3	19	0½
Take one-half	1	19	6¼
Add for cow hair, 9 lbs. at 5d.	0	3	9
Labour, preparing—12 hours, at 1s. 3¼d.	0	15	3
Cost per yard cube	2	18	

Detailed Cost per Yard Cube for Finishing Coat in Neat Sirapite.—

	£	s.	d.
1 yd. or 27 ft. cube "finish" Sirapite, at 2s. 4d.	3	3	0
Add for decrease in bulk, 17½ per cent.	0	11	0
Cost per yard cube	3	14	0

Nothing is added for the labour mixing as the material will be prepared when and as required by the labourer attending upon the plasterer.

Detailed Cost per Yard Cube for Undercoats for Metal Lathing (i.e. 1 part of Sirapite to 3 parts of Lime and Hair).—

	£	s.	d.
1 yd. or 27 ft. cube of "coarse" Sirapite, at 2s. 1½d.	2	17	4½
3 yds. cube of "coarse stuff" (see earlier item), at £1 os. 2½d.			6¾
	5	17	11¼
Add for decrease in bulk, 15 per cent.	0	17	8¼
Total for 4 yds. cube	6	15	7½
Take one-fourth	1	13	10⅞
Add labour, preparing—3 hours, at 1s. 3¼d.	0	3	9¾
Cost per yard cube	1	17	8¼

The manufacturers of "Sirapite" recommend that a small quantity of plasterers' putty be added to the first coating. If this is done and 3 ft. cube of putty is added, then the analysis would show a corresponding reduction in the quantity of "Sirapite."

The difference in cost is so small that a detailed analysis is not given.

Keene's Cement and Parian Cement.—These cements should be used as setting coats only, the undercoats being of Portland cement and sand. Lime plaster is not suitable for undercoats. The material is mixed as the work proceeds. One ton contains about 30 bushels, or 37 ft. cube, and consists of 10 sacks. A charge of 3d. each is made for sacks. The present price is £6 per ton delivered, and adding the cost of unloading (as for Portland cement) at 1s. 3¼d., and for use of sacks 2s. 6d., a total is obtained of £6 3s. 9¼d. per ton. This works out at 3s. 4¼d. per foot cube, or 4s. 1½d. per bushel. The material decreases in bulk when mixed with water and in application by about 16⅔ per cent., therefore 25 per cent. must be added.

Detailed Cost per Yard Cube ("Setting" coat in Keene's or Parian).—

	£	s.	d.
27 ft. cube Keene's or Parian, at 3s. 4¼d. . .	4	10	7
Add for decrease in bulk, 25 per cent. . . .	1	2	8
Labour, preparing—2 hours, at 1s. 3¼d. . .	0	2	6½
Price per yard cube	5	15	9½

Portland Cement.—Portland cement is used for external work principally, but is often required for internal work as an undercoat for Keene's or Parian; as a screed for tiling or for a "pricking up" coat on expanded metal lathing for hard plaster.

The costs per yard cube of Portland cement and sand in the proportions of 1 to 3, 1 to 2, and 1 to 1, are given in the data for mortars (see "Bricklayer"), and the costs may be taken therefrom; the only differences will occur in the prices for sand, and as it is a simple matter for these to be adjusted for different districts, no detailed analysis will be given at this stage.

White Portland Cement.—This is frequently used as a finishing coat on backings of ordinary Portland cement, and a detailed analysis is given earlier in "Bricklayer."

Roman Cement.—The usual proportions for this material are 1 to 1½ for undercoats and 1 to 1 for finishing coats. The material is sold by the ton, consisting of 10 sacks, and 1 ton contains about 30 bushels, or 37 ft. cube. The decrease in bulk is about equal to Portland cement.

Detailed Cost of Roman Cement per Bushel and per Foot Cube.—

	£	s.	d.
1 ton of Roman cement delivered. .	7	0	0
Use and waste of sacks, 10 at 3d. .	0	2	6
Labour, unloading—(as before) 1 hour .	0	1	3½
Cost per ton . . .	7	3	9½

Dividing by 30 gives the price per bushel of 4s. 9½d.
Dividing by 37 gives the price per foot cube of 3s. 10½d..

Detailed Cost per Yard Cube of Roman Cement Undercoat (1 to 1½).—

	£	s.	d.
1 yd. cube or 27 ft. cube Roman cement delivered, at 3s. 10½d.	5	4	7½
1½ yd. cube of washed sand, at 8s. 6d. . . .	0	12	9
	5	17	4½
Add for decrease in bulk, 22½ per cent.	1	6	5
Total for 2½ yds. . .	7	3	9½
Divide by 2½ gives	2	17	6
Add labour, mixing—12 hours, at 1s. 3½d.	0	15	3
Price per yard cube . .	3	12	9

Detailed Cost per Yard Cube of Roman Cement Finishing Coat (1 to 1).—

	£	s.	d.
1 yd. cube or 27 ft. cube Roman cement delivered, at 3s. 10½d.	5	4	7½
1 yd. cube of washed sand, at 8s. 6d. . .	0	8	6
	5	13	1½
Add for decrease in bulk, 20 per cent. . .	1	2	7½
Total for 2 yds.	6	15	9
Take one-half	3	7	10½
Add labour, mixing—12 hours, at 1s. 3½d. .	0	15	3
Price per yard cube	4	3	1½

Painter.

The preparation of basic data for mixed paint is somewhat difficult, as painters use the materials in different proportions, but the following will give sufficient information for comparative purposes. Owing to legislation, the use of white lead as a base will be restricted, therefore detailed costs for lead and zinc paints are given herewith. In comparing the cost of zinc paints with lead paints, it will be noticed that zinc paint takes slightly longer to prepare, but as explained later in Chapter XV., three coats of zinc paint may be necessary to obtain a surface equal to two coats of white lead paint, but the application will be less expensive for each coat. Although many decorating firms prefer to mix their own material, it is an undoubted fact that the use of ready-mixed paints is becoming more popular. Some years ago much of the ready-mixed paint was so poor in quality that reputable firms refused to use paint not prepared upon the job, but there is no doubt that if genuine White Lead, Linseed Oil, and Turpentine are used for the ready-mixed material, purchased from a first-class firm under a guarantee, a considerable saving can be effected, and the paint will be equal in quality. In the following costs white lead has been calculated at 44s. per cwt., i.e. 4¾d. per lb.

Detailed Cost for 1 *Gallon of Lead Paint.*—

Priming Coat.

	£	s.	d.
½ lb. red lead, at 3d.	0	0	1½
13½ lbs. white lead, at 4¾d.	0	5	4
7 pints linseed oil, at 2s. 7d. per gall.	0	2	3
¼ lb. patent driers, at 6d.	0	0	1½
Mixing—1 hour, painter, at 1s. 7d.	0	1	7
Price per gallon	£0	9	5

First Coat and Second Coat.

	£	s.	d.
14 lbs. white lead, at 4¾d.	£0	5	6½
½ gall. linseed oil, at 2s. 7d. per gall.	0	1	3½
½ gall. turps, at 4s. 3d. per gall.	0	2	1½
¼ lb. patent driers, at 6d.	0	0	1½
Mixing—1 hour, painter, at 1s. 7d.	0	1	7
Price per gallon	£0	10	8

THIRD COAT AND FOURTH COAT.

	£	s	d
18 lbs. white lead, at 4½d. . .	0	7	1½
5¼ pints linseed oil, at 2s. 7d. per gall.	0	1	8
1 pint turps, at 4s. 3d. per gall. .	0	0	6½
¼ lb. patent driers, at 6d. . .	0	0	1½
Mixing—1 hour, painter, at 1s. 7d.	0	1	7
Price per gallon . .	£0	11	0½

Detailed Cost for 1 Gallon of Zinc Oxide Paint.—

	£	s	d
10 lbs. zinc oxide, at 7½d. . .	£0	6	3
½ gall. linseed oil, at 2s. 7d. per gall.	0	1	3½
½ gall. turps, at 4s. 3d. per gall. .	0	2	1½
½ lb. special driers, at 8d. . .	0	0	4
Mixing—1½ hours, painter, at 1s. 7d.	0	2	4½
Price per gallon .	£0	12	4½

Detailed Cost for 1 Gallon of Lithopone Paint (Zinc Sulphide and Barium Sulphate).—

	£	s	d
18 lbs. lithopone, at 4d.	£0	6	0
½ gall. linseed oil, at 2s. 7d. per gall. . . .	0	1	3½
1 pint boiled linseed oil, at 3s.	0	0	4½
1 pint turps, at 4s. 3d. per gall.	0	0	6½
Mixing—1½ hours, painter, at 1s. 7d. . . .	0	2	4½
Price per gallon	£0	10	7

Weight of Linseed Oil and Turpentine.—

1 gall. linseed oil = 9¼ lbs.
1 gall. turpentine = 8⅔ lbs.

CARTAGE.

The quotations for cartage are usually made per ton, and the following approximate weights of the principal material to be carted may perhaps be useful, viz. :—

	cwts.
Loamy earth, per yard cube .	19
Earth from excavations, per yard cube	23
Gravel, per yard cube .	28
Sand, pit, per yard cube .	26
,, river, per yard cube .	29
Chalk, per yard cube . .	36
Coke breeze, per yard cube .	8
Lime mortar, per yard cube	30
Cement mortar, per yard cube	33
Bricks, Stock, per 1000 .	61
,, Flettons ,, . .	63
,, blue ,, . .	80

*Portland stone, per foot cube	.	.	about				1½	cwts
*Bath stone, ,, ,,	.	.	,,				1½	,,
*Timber, fir, ,, ,,	.	.	.	.			36	lb.
,, mahogany, ,, ,,	.	.	.	.			40	,,
,, teak, ,, ,,	.	.	.	.			40	,,
,, oak, ,, ,,	.	.	.	.			50	,,
,, pitch pine, ,, ,,	.	.	.	.			50	,,
Slates (24″ × 12″), per 1000	.	.	.	.			50	cwts.
,, (20″ × 10″) ,,	.	.	.	.			33	,,
Tiles, per 1000 . .	.	.	.	.			25	,,
Water, per gallon . .	.	.	.	.			10	lb.
1 ton of chalk lime	equals about		2	yds.	or	30	bushels	
,, grey stone lime	,,	,,	2	,,		40	,,	
,, lias lime	,,	,,	1½	,,		30	,,	
,, Portland cement	,,	,,	.			20	,,	
,, Sirapite plaster	,,	,,	.			35	,,	
,, plaster	,,	,,	.			30	,,	
,, Keene's or Parian	,,	,,	.			30	,,	

* The cartage of timber is a computed rate of 50 cub. ft. to the ton for soft woods, and 40 cub. ft. for hard woods. The railway computed weight for building stones is 16 ft. to the ton.

The weights given for limes must be used with caution, as these vary in different districts. Enquiries should be made locally.

CHAPTER III.

THE PRELIMINARY BILL.

It is usual to leave the actual pricing of this bill until all the trades bills are complete; in fact, it is impossible to price many of the items until the final total is known. Particularly does this apply to insurances and water, which are priced upon a percentage basis upon the amount of the contract, but there are other matters which cannot be valued until a visit has been paid to the site. There are many items that require no price at all which need not be mentioned here, but the items which usually require pricing are detailed in the same order of billing as given in "The Standard Method of Measurement" agreed upon by the Chartered Surveyors' Institution and the National Federation of Building Trades Employers, and the Institute of Builders.

Difficulties of Site.—A visit is necessary, and the price depends entirely upon local circumstances (see "Spot Items" later).

Date and Order of Completion.—If any special order is to be observed, or any special facilities given, a price may be necessary. If it is found that a certain portion of the work is to be carried out after the usual working hours, the probable number of men required and the amount of time necessary must be assessed for the particular task. This must be priced at the usual local rates for overtime, deducting therefrom the ordinary hourly rate, so that the overtime can be priced as "extra only," but in making such deduction provision must be made for decreased output, for it is natural that men cannot work at the same pace at the end of a day as at the beginning, especially with artificial light. The writer suggests that 20 per cent. be added to the "extra only" cost to cover the loss occasioned by decreased output, and if the work is to be continued on a Sunday it will be found that 50 per cent. is not too much to add.

Plant, Tools, and Scaffolding.—These items are analysed later in the trades concerned, and a price would appear in the preliminary bill only if special plant be required.

Notices and Fees.—Local enquiries must be made. In London there are fees due to the District Surveyors under the London Building Act and the L.C.C. General Powers Acts, often amounting to a considerable sum. These payments are detailed in the London Building Acts, and in the many text-books published thereon, also in Laxton's "Price Book." In certain towns no fees are required.

Sanitary Conveniences.—No charge is usually made for the structure (which is often constructed from old timber), and the price depends upon the circumstances. If pits are required the excavation can be priced as described in "Excavator," and a fresh pit is usually required every three weeks. The attention of a labourer for one hour per day is usually necessary.

Sheds, etc.—Unless special sheds are required for the storage of valuable fittings, usually no charge is made for these.

Protection of Public Property.—This is another "Spot Item," and prices are problematical. If water, gas, or electric light mains are affected, the local authority concerned will usually give an estimate for the work.

Foreman and Clerk of Works Offices, etc.—Often no charge is made for the actual structure, as some contractors treat this as ordinary plant included in overhead charges. The writer considers that 10 per cent. of the cost of material should be charged to each job, and the time erecting and dismantling in addition. This will work out at about £12 for a small office. For attendance, a labourer will be required for about two hours per day, and (except during the summer) lighting and fuel must be allowed for (say) ½ cwt. of coal and 1 gallon of oil per week of contract time.

Maintenance.—A few small defects are certain to appear, and although some provision must be made, this is a most speculative item. For jobs up to £3000 the writer suggests £10; for jobs up to £10,000, allow £15; and above this, up to £50,000, it is considered that £25 should be sufficient.

Damage to Persons and Property.—This is usually covered by an insurance policy for all jobs, but sometimes, owing to the special nature of the work, an additional policy may be necessary. If the building is over three storeys in height, enquiry should be made regarding the Employers' Liability

policy, as frequently extra premiums are necessary for buildings above this height.

Insurances Generally.—National Health and Unemployment Insurances are calculated upon the total of the job, and inserted at the end of the bill, a usual allowance being 1¼ per cent. on the contract. Fire insurance is usually 2s. 6d. per £100, unless there are special risks. Other insurances are covered by a general policy, and treated as overhead charges.

Lighting and Watching.—A watchman's wages are usually two-thirds the amount paid a labourer locally, and for the oil required a fair allowance would be 3 pints per lamp per week. The period for which such lighting and watching is required must be calculated, and this needs a considerable amount of judgment.

Foreman's Wages.—It is not usual to price this separately, it often being treated as an overhead charge, but if lodgings and "country money" are due, an amount is often inserted to cover same.

Removal of Rubbish.—The cost is usually borne by the items concerned, but if specialist sub-contractors are employed it may be necessary to provide an additional sum.

Shoring and Hoardings.—As it is now usual to give provisional quantities for these structures, they can be priced upon data obtained as described in "Carpenter," but it must be noted that licences are usually required, and a fee will be demanded.

Water.—There is considerable difference of opinion as to the method of charging the cost of water. It is usual to find in the preliminary bill an item such as "provide water for use on works and allow for all temporary plumbing," and sometimes this is added at the end of the bill in the Summary. In London this is very convenient, as the charges of the Metropolitan Water Board for a building supply are often calculated upon the approximate total cost of the building, usually 7s. per £100 of contract. Once the contract total is known, it is a simple matter to calculate the amount due for water. If he prefers, however, the contractor can purchase the water by meter, which, with proper supervision, is less expensive, and in such circumstances the probable cost of water for the whole job is more difficult to calculate; but there is another factor which may become important, especially now that charges for water are so high. If extra work is ordered for which water

is required, the prices at which such extra work will be measured and valued will be those appearing in the original priced Bill of Quantities, and unless the cost of water has been included in such items, the variations will actually be underpriced. If water is to be supplied by meter, in certain circumstances it might be advisable to allow for cost of water in the items requiring same. In the various examples given in this work no allowance has been made for water, as the charges vary to a considerable extent in different parts of the country, and occasionally water can be obtained free. If the circumstances suggest that it would be preferable for the cost of water to be borne by the trades concerned, then the pricing data given later must be amended accordingly. The following table gives the approximate number of gallons of water required for the various items, viz. :—

QUANTITIES OF WATER REQUIRED.

Concrete, per yard cube	22	gallons.
Brickwork, per rod (14 ins. reduced), in cement mortar	230	
,, ,, ,, ,, lime ,,	300	
,, per yard super (9ins. reduced), in cement mortar	$5\frac{1}{16}$	
,, ,, ,, ,, ,, lime	$6\frac{7}{8}$	
Stonework, per foot cube	$\frac{1}{4}$	
Plastering, two-coat work, per yard super	$2\frac{1}{4}$	
,, three-coat ,, ,, ,,	$2\frac{3}{4}$	
Distempering and whitening, per yard super	$\frac{1}{4}$	

(Latrines, ablutions, cleaning, and general purposes, $2\frac{1}{2}$ gallons for every £1 of contract.)

Attendance.—This item is important if there are sub-contractors, and a fair allowance would be 5 per cent. on the amount of such sub-contract. For the item, "Allow for all trades to attend upon other trades," a fair allowance would be one-quarter of 1 per cent. on the total contract.

Taking Down and Credits, also "Spot Items."—If these items occur in a Bill of Quantities, the pricing will be a matter of some difficulty, and the bill should be entrusted to an experienced surveyor. If quantities have been taken for the demolition of existing work, the task will be less difficult as regards the valuation of old materials, but the valuation of the labour "taking down" is always difficult to assess, and this, as well as "Spot Items," can only be priced on the site by those of wide practical experience with similar work.

Taking Down.—This is sometimes given in a combined bill headed "Taking down and credits," in which case it is advisable

to price the actual taking down upon its merits, and then to work out a separate bill of credits. The cost of pulling down, preparing old material for re-use, and carting away débris entirely depends upon the condition of the building and local circumstances, but the following data are submitted as a guide, viz. :—

Brickwork.—Pulling down, cleaning, and stacking bricks. Per rod reduced—two labourers, 35 hours each; per yard reduced—two labourers, 25 minutes each.

Concrete Floors and Pavings.—Taking up and breaking. Per yard super—two labourers, ¼ hour each.

Timber Framed in Roofs and Floors.—Pulling down and stacking per foot cube. Carpenter and labourer, 10 minutes each.

Boardings, Pulling Up and Stacking.—Per square super. Carpenter and labourer, ¾ hour each.

Staircases.—Per tread (to include all parts of staircases). Carpenter and labourer, ½ hour each.

Slating.—Taking off and stacking, per square. Two labourers, 2 hours each.

Tiling.—Taking off and stacking, per square. Two labourers, 2½ hours each.

Iron and Steelwork.—Taking down and stacking, per cwt. Two labourers, 2 hours each.

Lead Work.—Taking up and rolling, per cwt. Plumber and mate, 2 hours each.

Lead Soil Pipes.—Taking down, per foot run. Plumber and mate, 10 minutes each.

Lead Waste and Service Pipes.—Per foot run. Plumber and mate, 5 minutes each.

Lath and Plaster Work.—Pulling down and depositing into heaps—per yard super. One labourer, 10 minutes.

Wall Plastering.—Taking down and depositing into heaps, per yard super. One labourer, 15 minutes.

Cartage of Old Material.—If the materials are of no use upon the site, to the whole of the above it will be necessary to add the cost of cartage, and as quotations for this will probably be per ton, the following approximate weights of old materials are appended :—

APPROXIMATE WEIGHTS OF OLD MATERIAL.

	Per Rod Super (14 ins.).	Per Yard Super (9 ins.).
Brickwork in cement mortar	15¾ tons	7 cwts.
,, lime ,,	15¼ ,,	6¾ ,,
Concrete floors and pavings, 6 ins. thick		5¼ ,,
,, from foundations, per yard cube		31½ ,,
Timber (fir), per foot cube		36 lbs.
Boardings, 1 in. per square		2¼ cwts.
,, 1¼ ,, ,, ,,		3⅓ ,,
Doors (1¼ in.), ordinary, each		38 lbs.
,, (1¼ in.), large, each		50 ,,
Slates, per square		6 cwts.
Tiles, ,, ,,		11 ,,
Old lath and plaster work, per yard super		50 lbs.
Bath stone, per foot cube		1¼ cwts.
Portland stone, per foot cube		1½ ,,
York stone, 3 ins. thick, per foot super		36 lbs.

Credits for Old Material.—The value of old material is speculative, for in some cases it is useless, whilst in other cases bricks, tiles, and similar material may be worth more than the price of new when delivered to the site. As a very rough guide, it is suggested that at the present time bricks, slates, and tiles will be worth the same price as new, plus the cost of cartage to the site; lead and other metals about two-thirds the cost of new; and timber about half the price of new. From the actual quantities of material, about 25 per cent. should be deducted for waste.

Credit for Material Found upon Site.—This principally applies to sand and gravel. Care must be taken to see that too great an allowance is not made, and, if possible, trial holes should be excavated and the nature of the soil examined, but this is not always convenient. If the specification states that sand and ballast found upon the site may be used by the contractor, the best method of fixing a price is to work out the cost of digging and forming into heaps, as described later in "Excavator," and after making allowance for the increase in bulk of material after excavation, to work out the cost per yard cube as excavated, and to include this in the analyses of the items for site concrete, concrete floors, or mortar, etc. If a lump sum is given in the Bill of Quantities as a credit, it becomes extremely difficult to adjust "Extras and Omissions."

Increase in Bulk of Excavated Material.—One cubic yard before excavation of the following material increases as follows :—

Sand	1¼ yd.
Gravel	1⅓ ,,
Earth	1¼ ,,
Chalk	1⅓ ,,

"*Spot Items.*"—These items are always difficult to price, and much depends upon the experience of the Estimating Surveyor. "Spot Items" usually occur with alterations and additions to existing structures, but in a Bill of Quantities for new premises there are often a few "Spot Items." This bill should not be priced without a visit to the site, as the risk is considerable. Some years ago the writer had to price a Bill of Quantities which contained a statement in the preamble that the plans and specifications were based upon the assumption that the site was level, and the contractor was to make all allowance in his price for difference in levels. Approximate levels were taken, and although the site appeared to be level, it was found that actually a great variation existed, and considerable extra work was necessary, the approximate cost of which amounted to £200. A properly prepared Bill of Quantities would give the exact amount of excavation necessary, but the Estimating Surveyor should take no risks, and examine the site. There is frequently a clause stating that the contractor is to make good to gardens and adjoining property; this may mean special fencing, and perhaps shoring may be necessary, for which measurements must be taken.

In bills for repairs and for additions, such items occur as taking out doors and windows; and bricking up openings, plastering in detached places, re-using joinery after repairing same, shoring-up walls and ceilings; also pulling down small portions of work and inserting steel joists. To price such items, the surveyor should measure up and take out the actual quantities of all material that can be measured, and then assess the value of the labour upon a time basis. He must visualise the job in his mind whilst he is on the site, and then consider the number of men required for the work, with their assistant labourers; he must then calculate the number of hours required for the task, noting any special difficulties. It is obvious that this is a matter calling for wide experience, and no data can possibly be given.

CHAPTER IV.

EXCAVATOR AND CONCRETE (INCLUDING TEMPORARY TIMBERING).

Increase and Decreases in Bulk.—It is important to remember with regard to "Excavator," that 1 yd. cube of ordinary earth before excavation becomes 1¼ yd. cube when excavated, and that cement, sand, and ballast diminish in bulk upon being mixed. Gravelly soil increases in bulk by about one-eighth and rock up to as much as one-half.

Wheeling, Filling, and Ramming.—In dealing with "Excavator" items, some wheeling is necessary. If the distance of spoil-heap is, say, 50 yds., then it must be remembered that this distance will be traversed four times. Once to deposit, once to return with the empty barrow; then, at a later date, one journey to the heap with the barrow will be necessary, and one journey back with the earth, making four in all. As the spoil-heap becomes somewhat consolidated, it will be necessary to allow for a labourer to dig and load into barrows, and this is worth about 1 hour per yard. As regards filling and ramming, two men should fill and ram about 2 yds. per hour.

Cost of Planking and Strutting.—This is a very difficult item to price; it being for the use and waste of timber, also the labour fixing and afterwards removing. A certain amount of timber is wasted upon each occasion, and the writer is of opinion that the timber cannot be used more than six times. This means that each job must bear the cost of one-sixth of the total cost of the timber. Typical items are given later to show the method of arriving at prices.

Nature of Soil and its Excavation.—It is obvious that the nature of the soil will affect the cost of digging, and careful enquiries should be made in the neighbourhood of the job. In

the following calculations it is assumed that the time taken per yard cube will be as follows : Loamy soil, 1¼ hours ; clay, 2 hours ; chalk, 2¼ hours ; and rock, 4 hours. If the excavation is in trenches, it is suggested that 20 per cent. should be added to these figures.

Temporary Timbering.

In accordance with the 1935 Standard Method of measurement planking and strutting is to be given in feet super generally for basements and similar work for the full depth of excavation, but for trenches and pier holes the work is to be given in stages of 5 ft. in depth. For the latter items it will be more convenient to calculate the cost of the whole of the timber for a typical excavation and find the cost of the material only per foot super, and afterwards add for the labour separately. The timber is rough, and an average price of 3s. per foot cube is assumed ; to obtain the prices per foot run therefrom the reader is referred to Chapter II. (Carpenter).

If the reader wishes to check the dimensions for temporary timber items he will find illustrations in Mitchell's " Advanced Building Construction " of all the following examples. Mr. George Mitchell, F.R.I.B.A., of the Polytechnic, Regent Street, London, very kindly gave his permission to the author to use them.

Detailed Costs.—

Planking and Strutting to Sides of Excavation (as for Basements).—For the purpose of this calculation it is assumed that the depth is 10 ft. ; that there are three walings ; that shores and uprights are placed at intervals of 6 ft. from centre to centre. If a typical length of 6 ft. (on plan) is taken, one complete shore will be included. The following timbers are assumed, viz. : poling boards, 9¼″ × 1½″ ; walings, 6″ × 8″ ; uprights (cut between walings), 9″ × 6″ ; shores (similar to "rakers "), 9″ × 9″, one of which is 16 ft., one 13 ft., and one 12 ft. in length ; sole-plate, 11″ × 3″, and 3 ft. in length. Struts to shore formed of 9″ × 1½″ boarding both sides of shore ; iron dogs are assumed as 3 each side of shore at the sole-plate, and 1 each side of shore where it adjoins the upright.

Analysis.—

		£	s.	d.
6·0 10·0 ——	60·0 sup. 1½″ poling boards, at 4½d. . .	£1	2	6
3/6·0 ——	18·0 run 6″ × 8″ walings, at 1s. . .	0	18	0
7·0 ——	7·0 run 9″ × 6″ uprights, at 1s. 1½d. .	0	7	11
16·0 13·0 12·0 ——	41·0 run 9″ × 9″ shore, at 1s. 8¼d. . .	3	9	2
2/2·3 4·0 —— 2/2·3 6·0 ——	18·0 27·0			
	45·0 sup. 1½″ rough boarding, at 4½d. .	0	16	11
No. 8 wrought-iron dogs, at 1s.		0	8	0
		£7	2	6
Add for waste, 5 per cent.		0	7	1½
Total first cost of timber . . .		£7	9	7½
It is assumed that the timber will be useless after it is used for six occasions, therefore take one-sixth as use and waste of timber		£1	4	11½
Add for nails, 2 lbs. at 2d.		0	0	4
4 labourers unloading and erecting timber, 6 hours, at 5s. 1d.		1	10	6
4 labourers, taking down and loading to lorry, 2 hours, at 5s. 1d.				
Carpenter and labourer cutting, shoring timbers on job, 3 hours, at 2s. 11½d.		0	8	9¾
Cost for 60 ft. super . . .		£3	14	9

Dividing the above total by 60 gives the price per foot super of (say) 1s. 3d.

The cost of transport must be added, and this depends upon the distance, but as the typical example contains nearly 45 cub. ft. of timber, and timber is carted by weight, the cost can be readily ascertained. From the above calculation, it will be seen that 1 ft. super of planking and strutting for a basement is equal to $\frac{3}{4}$ ft. cube of timber. The actual weight of the timber complete per foot super of measurement is 27 lbs.

Planking and Strutting to Sides of Excavation for Stanchion Bases or Pier Holes.—In the following calculation

a depth of 15 ft. will be assumed, and that the shaft is 5 ft. × 5 ft. in area (measured inside of shuttering—i.e. 5′ 3″ × 5′ 3″ of excavation). This particular work requires very careful calculation, and differs very much from ordinary planking and strutting. As the timbers at the lower part of the shaft will of necessity be moved first, additional members are required to prevent the upper planking slipping down when the lower timbers are removed. Often this is effected by fixing two cross-beams at the top and at the bottom of the shaft or, if the shaft is very deep, extra beams may be fixed at intervals. To these beams a "hanger" is notched and bolted; two "hangers" only are needed, i.e. on opposite sides of the shaft. The walings are notched to the "hanger" and well spiked.

It is necessary for the cross-beams in the shaft to project into the earth each side, therefore they cannot be fixed in one length, to fix them in two pieces necessitates a scarfed joint. In depth it is necessary for the poling boards to overlap 18 ins. in every 5 ft., and the whole of the timbering must extend to a height of about 3 ft. above the level of the adjacent ground; allowances must be made for extra timber in both cases. If the shaft is only 5 ft. deep, or less, then no allowances need be made for overlap or extra height or for cross-beams and hangers.

The following timbers are assumed, viz. :—

Poling boards, 9″ × 1½″; walings, 4″ × 4″ (spaced 2′ 6″ apart, centre to centre); angle posts, 4″ × 4″; hangers, 9″ × 3″; cross-beams, 11″ × 9″.

Analysis.—

21·0		
21·0		
441·0	sup. 1½″ boarding, at 4½d. . .	£8 5 5
4/15·0		
60·0	run 4″ × 4″ angle posts, at 4d. .	1 0 0
8/5·0	40·0	
8/4·4	34·8	
74·8	run (say 75 ft.) 4″ × 4″ walings, at 4d.	1 5 0
8/4	No. 32 cleats (9″ × 6″ × 3″), at 3½d. .	0 9 4
2/8·0	16·0	
Scarf	2·0	
18·0	run 11″ × 9″ cross-beams, at 2s. 1d. .	1 17 6
2/18·0		
36·0	run 9″ = 3″ hangers, at 6½d. . .	1 0 3
		£13 17 6
	Add for waste, 5 per cent. . .	0 13 11
	Total first cost of timber	£14 11 5

Take one-sixth of cost for use and waste as before .	£2	8	7
2/4 No. 8 bolts, at 9d.	0	6	0
2/8/3 No. 48 heavy spikes, at ¼d.	0	1	0
Carpenter forming " scarf," 3 hours, at 1s. 8d. .	0	5	0
Carpenter forming notches, 2 hours, at 1s. 8d. .	0	3	4
Use and waste of material	£3	3	11

The net measurement of the above as given in a Bill of Quantities would be 315 ft. super, therefore the cost per foot super for timber is (almost) 2½d. The time taken by two labourers would be—

(*a*) for the first 5 ft.—6 hours, at 2s. 6½d. . .	£0	15	3
(*b*) for the second 5 ft.—8 hours, at 2s. 6½d. . .	1.	0	4
(*c*) for the third 5 ft.—10 hours, at 2s. 6½d. .	1	5	5

As each stage amounts to 105 ft. super, if the above figures are divided by 105, the following labour prices per foot super are obtained, viz.: (*a*) 1¾d.; (*b*) 2¼d.; (*c*) 3d., which makes the total for each stage of 4¼d., 4¾d. and 5½d. per foot super respectively (not including cartage). The weight of the above planking and strutting works out at 1 lb. per foot super.

Planking and Strutting to Sides of Trenches (not exceeding 5 ft. deep, both sides measured).

This calculation is fairly simple, and the trench will be assumed as 5 ft. deep and 3 ft. wide, and close boarded. The following timbers will be required, viz.: Poling boards, 7″ × 1½″; walings, 2″ × 6″ (two only in height); struts, 4″ × 4″ (spaced 4 ft. centre to centre). A typical length of trench 4 ft. long will be assumed so as to include one pair of struts.

Analysis.—

2/4·0 5·0 –40·0 sup. 1½″ boarding, at 4½d. .	£0	15	0
2/2/4·0 –16·0 run 2″ × 6″ walings, at 3d. . . .	0	4	0
2/2·9 –5·6 run (say 6 ft.) 4″ × 4″ struts, at 4d. .	0	2	0
	£1	1	0
Add for waste, 5 per cent.	0	1	1
Use and waste of material	£1	2	1
Take one-sixth (as before)	£0	3	8
2 labourers, fixing and striking, 1½ hours, at 2s. 6½d.	0	3	9¾
Cost per 40 ft. super	£0	7	5¾

Dividing by 40 gives the price per foot super of 2¼d.

The weight of the above planking and strutting is 0·8 lb. per foot super.

If the trench is required to be 10 ft. deep, then allowance must be made for the lap (as described for pier holes), and for flat boarding for a throw, i.e. 11 ft. super per length of 4 ft. of trench, and two labourers would require 2 hours for the depth below 5 ft. up to 10 ft., and 2½ hours, 10 ft. to 15 ft. deep.

Open Planking and Strutting.—This method can be used if the soil is fairly compact. In a typical length of 4 ft., with a depth of 5 ft. and a width of 3 ft., the following will be assumed, viz.: three poling boards each side, one waling board each side, and one strut.

Analysis.—

	£	s	d
2/3/5·0 ——— 30·0 run 7″ × 1½″ planking, at 2¼d. . .	0	6	10
2/4·0 ——— 8·0 run 2″ × 6″ walings, at 3d. . . .	0	2	0
2·9 ——— 2·9 run (say 3 ft.) 4″ × 4″ strut, at 4d. .	0	1	0
	£0	9	10
Add for waste	0	0	6
Use and waste of material	£0	10	4
Take one-sixth	£0	1	9
2 labourers, fixing and striking, ¾ hour, at 2s. 6½d.	0	1	10¾
Cost per 40 ft. super	£0	3	7¾

Dividing by 40 gives the price per foot super of slightly more than 1d.

EXCAVATING.

The following prices assume that no labour-saving machinery is used, and that the excavator is paid 1d. per hour more than the labourers' rate.

In accordance with the Standard Method of Measurement (1935), the disposal of the earth after excavation is to be the subject of a separate measurement, except for such items as shallow trenches and similar work in small quantities.

Detailed Costs.—

Excavate as in Basements and Throw Out (not exceeding 5 ft. deep).

	£	s	d
Excavator (in compact loam), 1¼ hours, at 1s. 4½d.	£0	1	8½
Price per yard cube	£0	1	8½

Excavate as in Basements and Basket Out (not exceeding 5 ft. deep).

	£	s	d
Excavator (in compact loam), 1¼ hours, at 1s. 4½d.	£0		8½
Labourer removing earth, 1¼ hours, at 1s. 3½d. .	0		7
Price per yard cube	£0	3	3½

Excavate in Trenches and Throw Out (not exceeding 5 ft. deep).

	£	s	d
Excavator (in compact loam), 1½ hours, at 1s. 4½d.	£0	2	0½
Price per yard cube	£0	2	0½

Excavate in Trenches and Throw Out (exceeding 5 ft. and not exceeding 10 ft. deep).

	£	s	d
Two Excavators (in compact loam), 1 hour, at 2s. 8½d.	£0	2	8½
Additional Excavator, throwing earth to surface, 1 hour, at 1s. 4½d.	0	1	4½
Price per yard cube	£0	4	0¾

All excavation items are kept in stages of 5 ft., therefore from 5 ft. to 10 ft. a " throw " occurs.

Additional labour is required to remove the excavated earth from the first staging to the ground level, and the earth being loose it is assumed that one assistant can attend upon two excavators, therefore only half the time that is allowed an excavator is necessary. If the excavation exceeds 10 ft., then an additional assistant is needed, and so on for every stage of 5 ft. in depth.

Excavate in Trenches (not exceeding 5 ft. deep), **Wheel and Deposit a Distance** of 50 yds.

	£	s	d
Excavator (in compact loam), 1½ hours, at 1s. 4½d.	£0		0½
Labour, wheeling to spoil-heap, 1 hour, at 1s. 3¼d.	0		3¼
Price per yard cube	£0	3	3¾

In this latter item it is assumed that one man can load and wheel 1¼ yd. cube per hour, including the return journey with an empty barrow.

Fill Excavated Material into Carts and Cart Away to Shoot.

	£	s	d
Filling into carts, 2 labourers, ½ hour, at 2s. 6½	0	0	10
Cartage, quoted at 4s. per load	0	4	0
Price per yard cube	0	4	10

The price for carting depends upon the distance and the charge for "shoot."

Return, Fill, and Ram Excavated Material (not exceeding 5 ft. deep) from spoil-heap 50 yds. distant.

	£	s	d
Labourer, digging spoil-heap and filling barrow, 1 hour, at 1s. 3¼d.	0	1	3¼
Labourer, wheeling and depositing soil and returning with empty barrow, 1 hour, at 1s. 3¼d.	0	1	3¼
Excavator, filling and ramming, 1 hour, at 1s. 4¼d.	0	1	4¼
Price per yard cube	0	3	10¾

Remove Top Soil (not exceeding 12 ins. deep), **Wheel and Deposit as Directed,** not exceeding 50 yds. distant. If the item for "excavate in basement" and "throw out" is worth 1s. 8½d. per yard cube, and the item for "wheel and deposit" at 1s. 3¼d., a total of 2s. 11½d. per yard cube is obtained (say 3s.). As the required price is to be per yard super and 12 ins. deep, if 3s. is divided by 3, the figure of 1s. is obtained, which represents the price of a yard super, 1 ft. deep (1 ft. being ⅛ of the 3 ft. in depth which would make a yard cube).

The following price is obtained therefore :—

	£	s	d
Excavate and deposit (as previous items)	0	1	0
Level up surface, Excavator, ⅛ hour, at 1s. 4¼d.	0	0	2
Price per yard super	0	1	2

Hard Core.

The price of this material varies considerably, and quotations should always be obtained. A reduction in bulk takes place with ramming.

Detailed Prices.—

Hard Core Well Rammed and Consolidated.

	£	s	d
1½ yd. brick rubble delivered and shot.	0		6
Labourer, filling and ramming, 2 hours, at 1s. 3¼d.	0		
Price per yard cube	0	6	0½

Hard Core 6 ins. Thick, Spread and Levelled Over Site.—If the price of the previous item (6s. o½d.) is taken and divided by 6 (6 ins. being one-sixth of 36), the figure of 1s. is obtained, but an extra allowance must be made for the levelling.

1 yd. super of hard core 6 ins. thick . . .	£0	1	0
Extra time spreading, Labourer, ¼ hour, at 1s. 3½d. (say 4d.)	0	0	4
Price per yard super	£0		

CONCRETE.

The apparent shrinkage or reduction in bulk which takes place in the preparation of concrete depends upon the percentage of voids contained in the particular aggregate used. If a sample of an ordinary ungraded sand is sifted through fine sieves of different sized meshes, it will be found that the total volume of the different graded sands is less than the volume of the sand before grading.

Dr. Leask Manson, in his "Experimental Building Science," gives some very interesting laboratory experiments to illustrate this fact, also the reduction in bulk which takes place with larger aggregates before mixing and after mixing with water. In "Everyday Uses of Portland Cement" (published by the Cement Marketing Company), the results of practical experiments with larger quantities of materials are given, and the results obtained by both methods are very similar. The writer has permission to quote from both books. With carefully graded materials, the reduction in bulk, due to the careful mixture and consequent filling of voids, is considerable. With ungraded materials, such as ballast already containing sand, the reduction in bulk is not so great and this means that all the voids are not filled.

The use of carefully graded materials is extremely important for reinforced concrete, and will be mentioned again in the Chapter "Reinforced Concrete Engineer." Unsifted Thames ballast contains too much sand; in a 1 to 4 mixture (which is often mistaken for 1 : 2 : 4) there is but little reduction in bulk. With fine graded materials the final reduction has been found to be between one-quarter and one-third of the total volume of materials before mixing. With ungraded materials the cement only helps to fill some of the voids.

In preparing analyses, using the yard (or foot) cube as a unit of measurement, it is very convenient to calculate the quantity of materials in the proportions specified, and then to add a percentage for reduction in bulk. If therefore the material diminishes to the extent of one-third, or 33⅓ per cent., then one-half or 50 per cent. must be added, or if the material diminishes by 20 per cent., then 25 per cent. must be added.

Dr. Leask Manson gives an interesting calculation, showing materials required for a cubic yard of concrete to a given specification, viz.: 1 : 2 : 4 with a known reduction accompanying the mix of 28 per cent. The quantities of material required are coarse material, 21·14 cub. ft.; sand, 10·7 cub. ft.; and cement, 5·35 cub. ft., a total of 37·5 cub. ft. for 1 yd. cube of concrete.

The above materials therefore diminish by 28 per cent.

In the calculation which follows later, an addition would have to be made of 38·8 per cent. to cover this.

It is interesting to note in "Everyday Uses for Portland Cement," that with ballast having 40 per cent. voids with a mix of 1 : 2 : 4 the result for one yard cube of concrete is ballast, 0·86; sand, 0·43; and cement, 0·21 (or 520 lbs.), making a total of 1·5 yds. cube or 40·5 ft. cube. In this case the materials have diminished in bulk by 33⅓ per cent. By kind permission the table is given herewith :—

Materials for 1 Cubic Yard of Concrete.—

Based on dry sand weighing 89 lbs. per cubic foot and loose cement 90 lbs. per cubic foot, with an average specific gravity of 3·12.

Proportions.	Lbs. Portland Cement in 1 cubic yard.	Sand cubic yards in 1 cubic yard.	Aggregate cubic yards in 1 cubic yard.
1 : 1½ : 3 Ballast (40 per cent. voids)	663	·41	·82
1 : 1½ : 3 Broken stone (45 per cent. voids)	700	·43	·86
1 : 2 : 4 Ballast	520	·43	·86
1 : 2 : 4 Broken stone	548	·45	·90
1 : 2½ : 5 Ballast	430	·44	·88
1 : 2½ : 5 Broken stone	450	·46	·92
1 : 3 : 6 Ballast	364	·45	·90
1 : 3 : 6 Broken stone	383	·47	·94
1 : 4 : 8 Ballast	280	·46	·92
1 : 4 : 8 Broken stone	294	·48	·97

In all calculations herein, cement has been taken at 90 lbs. per foot cube. One yard cube of cement equals 2430 lbs., or 1 ton 1 cwt. 78 lbs., and for the calculations that follow, a yard cube will be considered as worth £2 5s., i.e. at £2 1s. 3d. per ton (see Chapter II. for detailed cost).

The saving effected with mechanical plant is described in another Chapter.

Detailed Costs.—

Portland Cement Concrete (1 to 6) in Foundations, aggregate consisting of ballast and sand (ungraded).

	£	s.	d.
1 yd. cube Portland cement, at £2 1s. 3d. per ton	£2	5	0
6 yds. aggregate, at 7s. 3d.	2	3	6
	£4	8	6
Materials will decrease in bulk by 20 per cent., so an addition of 25 per cent. must be made	1	2	1½
Total for 7 yds. cube	£5	10	7½
Take one-seventh	£0	15	9½
Mixing and laying, 4 hours, at 1s. 3¼d.	0	5	1
Price per yard cube	£1	0	10½

In the above example the cement will be lost entirely in filling part of the voids, making an initial decrease of one-seventh of the whole bulk (about 14 per cent.), and the remaining materials will decrease by about 6 per cent.

With graded materials the voids are properly filled.

Portland Cement Concrete (1 to 6) in Foundations, aggregate consisting of 4 parts of broken stone and 2 parts of coarse sand (ungraded).

	£	s.	d.
1 yd. cube Portland cement, as before	£2	5	0
2 yds. cube coarse sand, at 6s. 6d.	0	13	0
4 yds. cube broken stone, at 7s. 6d.	1	10	0
	£4	8	0
Bulk will diminish by 25 per cent., so 33⅓ per cent. must be added	1	9	4
Total for 7 yds. cube.	£5	17	4
Take one-seventh	£0	16	9
Mixing and laying, as before.	0	5	1
Price per yard cube	£1	1	10

Portland Cement Concrete (Gauged 1 : 2 : 4) in Foundations, aggregate consisting of broken ballast to pass a 1 in. mesh and with graded sand.

	£	s.	d.
1 yd. cube Portland cement, as before . .	£2	5	0
2 yds. cube washed sand, at 8s. 3d. . .	0	16	6
4 yds. cube broken ballast, at 8s. 6d. . .	1	14	0
	£4	15	6
Bulk will diminish by 33⅓ per cent., so 50 per cent. must be added	2	7	9
Total for 7 yds.	£7	3	3
Take one-seventh	£1	0	5½
Mixing and laying, 5 hours, at 1s. 3½d. . . .	0	6	4½
Price per yard cube	£1	6	9½

Lias Lime Concrete in Foundations (1 to 6), consisting of 4 parts of broken stone and 2 parts of coarse sand (ungraded), and 1 part of lias lime.

	£	s.	d.
1 yd. (i.e. 27 ft. cube) lias lime, at 1s. 0¾d. (see Chapter II.)	£1	8	8
2 yds. coarse sand, at 6s. 6d.	0	13	0
4 yds. broken stone, at 7s. 6d.	1	10	0
	£3	11	8
Bulk will diminish by 25 per cent., so 33⅓ per cent. must be added	1	3	11
Total for 7 yds.	£4	15	7
Take one-seventh	£0	13	8
Mixing and laying, 4 hours, at 1s. 3½d. . . .	0	5	1
Price per yard cube	£0	18	9

Concrete Items Priced per Yard Super.—Many concrete items, such as beds not exceeding 12 ins. in depth, are billed per yard super, and an additional labour added for any extra work in spreading and levelling for a special finish to the face. If the yard cube is considered as plastic material from which slices of any depth can be cut, the method of obtaining the price per foot super is quite simple, i.e. if the price of a bed 12 ins. thick is required, take one-third of the price per yard cube; if a thickness of 6 ins. is required, take one-sixth, 6 ins. being one-sixth of 36 ins. or 1 yd. For spreading and levelling, add ½ hour per yard, and if with "spade finish," add ¾ hour per yard super.

Detailed Cost.—

Portland Cement Concrete (1 to 6), aggregate consisting of broken stone and coarse sand as before, 6 ins. thick, **spread and levelled, and with spade finish.**

1 yd. super concrete, at £1 1s. 10d. per yard cube, i.e. one-sixth	£0	3	7¾
Extra labour, spread, level and spade finish, ¾ hour, at 1s. 3½d.	0	0	11½
Price per yard super	£0	4	7¼

In making any comparisons between items with graded and ungraded materials, the reader should note that as in the first examples the cement is lost in the voids, yet the result is divided by the total number of yards of material—this fact has been considered in fixing the percentage for reduction in bulk. Concrete lintels, encasements, and upper floors are dealt with in "Reinforced Concrete Engineer," and concrete pavings in "Pavior."

Waterproofed Concrete.—It is now common practice to add a waterproof powder, such as "Pudlo" brand waterproofer.

The various proportions can be obtained from the makers, but the amount of powder required is never more than 5 per cent. by weight to the cement, and this is for waterlogged ground. In concrete suitable for foundations or floors in the proportions of 4 : 2 : 1, 1 yd. cube of concrete would require 10⅓ lbs. of waterproofer, which is 2 per cent. of the weight of the cement.

This proportion is quite sufficient, provided a good and suitably graded aggregate is used. It is usual to specify the proportion by a percentage to the weight of the cement.

In preparing an analysis, it must be noted that 2 per cent. by weight (of the cement) is equal to nearly 5 per cent. by bulk, because cement weighs more than twice as much as the powder, bulk for bulk. The material costs about 11½d. per lb. delivered, including cost of packages, and if the order is a large one, the material can be obtained in paper bags, each containing just sufficient powder for one mixing by a machine.

In a mix of 4 : 2 : 1, the addition of the powder will increase the bulk of the materials by 5 per cent. of the cement, i.e. $\frac{1}{20}$ of 1 yd. cube; the actual proportions therefore are 4 : 2 : 1 : $\frac{1}{20}$.

In preparing a detailed price it will be necessary to divide by $7\frac{1}{20}$ or 7·05, instead of 7 as with the former example.

Detailed Cost.—

Portland Cement Concrete (1 : 2 : 4), all as before described, but gauged with "Pudlo" brand waterproofer in the proportion of 2 per cent. to the weight of the cement.

	£	s.	d.
7 yds. cube of concrete (as all described in former example)	7	3	3
72½ lbs. "Pudlo," at 11½d. per lb.	3	7	9½
Total for $7\frac{1}{20}$ yards cube	10	11	0½
Divide by 7·05	1	9	11½
Add for labour, mixing, and laying, 5 hours, at 1s. 3½d.	0	6	4½
Price per yard cube	1	16	3½

The decrease in bulk of the waterproof powder is so small as to be negligible.

CHAPTER V.

BRICKLAYER.

Brickwork.—This is one of the most important sections of a Bill of Quantities, for unless the structure is built of material other than brick, the bricklayer's bill will often account for one-third of the total amount of the whole building. In consequence of this fact, it is a good plan to price the bricklayer's bill first and to leave the less important bills till those more important have been priced, so that in the event of being pressed for time when the estimate is nearing completion (and this is the rule rather than the exception), the bricklayer's bill will receive the attention it requires. Prices vary in different parts of the country owing to differences in sizes of bricks, thicknesses of mortar joints, and methods of bonding; also, the units by which brickwork is billed vary. The "Standard Method of Measurement" states that brickwork is to be billed by the rod of 272 ft. super, reduced to a standard thickness of 1½ bricks, but it also gives as an alternative a standard of 1 yd. super reduced to 1 brick thick, which latter standard applies principally to the Midlands and the North of England. Work exceeding 3½ bricks in thickness can be billed per yard cube.

In order to price the bulk brickwork, it is obvious that it is necessary to know the number of bricks required for a standard rod (1½ bricks thick), or a standard yard (1 brick thick), also the quantity of mortar required. Many persons estimating assume 4500 bricks are required to the rod, and ignore such questions as size, quality of bricks, and thickness of joints, but these matters are really important.

London and South of England Practice.

Number of Bricks per Rod.—The standard size for bricks (known as the R.I.B.A. Standard) was fixed in 1904 by the

Royal Institute of British Architects, the Brickmakers' Association, and the Institute of Civil Engineers as follows :—

Minimum	$8\frac{7}{8}'' \times 4\frac{5}{16}'' \times 2\frac{5}{8}''$
Maximum	$9'' \times 4\frac{3}{8}'' \times 2\frac{11}{16}''$

The length of a brick, including joints, to measure, centre to centre, $9\frac{1}{4}$ ins., and the height of four courses of bricks, including joints, to be 1 ft. This gives $\frac{1}{4}$ in. for each vertical joint and $\frac{5}{16}$ in. for horizontal joints.

To calculate the number of bricks required for a typical rod is not difficult, but for the instruction of beginners the writer gives the procedure. Assume a standard rod built in English bond, $16\frac{1}{2}$ ft. in length and $16\frac{1}{2}$ ft. in height and $1\frac{1}{2}$ bricks (or $13\frac{1}{2}$ ins.) in depth. One stretcher course of $16\frac{1}{2}$ ft. divided by $9\frac{1}{4}$ ins. gives $21\frac{1}{2}$ bricks, and behind this there is a header course containing double this quantity, i.e. 43, and assuming that in each header course half a brick is wasted in forming the closer, it will be found that one complete course in a wall $16\frac{1}{2}$ ft. in length and $1\frac{1}{2}$ bricks thick requires 65 bricks. The standard height being four courses to a foot, multiplying $16\frac{1}{2}$ by 4 gives a total of 66 bricks in height; therefore multiplying 66 by 65 gives the nett number of bricks per rod as 4290; but to this total allowances must be made for waste. With Fletton bricks, and others equally as hard, little damage will occur from breakages; also, there are practically no "throw-outs," and if the work is straightforward with but few openings occurring, an allowance of 1 per cent. should be sufficient. London Stocks, and similar bricks, are more brittle, but there are a few "throw-outs," therefore an allowance of 2 per cent. is suggested for plain work. Local Stocks purchased "as they rise" will contain a considerable number of "throw-outs," and breakages will be more frequent, so that an allowance of 5 per cent., up to perhaps as much as 10 per cent., will be necessary. It is obvious that information should be obtained regarding the bricks to be used before calculating the number required per rod, and that data based upon the use of one class of brick is not reliable for bricks of another class. If the work is pierced by many openings (and this can be ascertained only by inspecting the drawings for the job), then it will be necessary to increase the allowance for waste, for although extra cuttings are measured and detailed in the Bill of Quantities, the formation of door and

window openings is not mentioned specifically, so that if many occur the waste in bonding and cutting is considerable. Working upon the percentages given, the number of bricks required per rod will be as follows :—

Flettons, 4333 bricks ; Stocks, 4376 bricks ; Common Locals 4505 bricks.

The above figures are used in the calculations given later, but the student must bear in mind that the allowances for waste must be considered carefully, and must be based upon the quality of the brick, the nature of the work, transport and handling difficulties, and risk of damage.

The previous calculation is based upon English bond, and it is not considered necessary to work out other bonds, for by calculation it will be found that with a wall built in Flemish bond the difference in the number of bricks required is so slight as to be negligible, although Flemish bond will permit the use of a greater number of " bats."

Number of Bricks per Rod in 9-in. Walls (Reduced Brickwork).—Walls 9 ins. thick are now more common than formerly, especially for small houses, and in these circumstances it may interest the student to calculate the number of bricks required for such walls. In a Bill of Quantities for work in London and in the South of England, the work in one brick " unfaced " walls will be " reduced " to the standard rod of $1\frac{1}{2}$ bricks, and the following calculation applies to such work only. Calculations for work in other districts are given later. Assuming a wall $16\frac{1}{2}' \times 16\frac{1}{2}'$ as before, one stretcher course of $16\frac{1}{2}$ ft. contains $21\frac{1}{2}$ bricks upon the face, and doubling this for the back course gives 43 bricks per course. The header course naturally will contain the same number of bricks, and allowing half a brick for every alternate course for waste in forming closers, gives 2855 bricks for the 66 courses, i.e. $16\frac{1}{2}$ ft. in height. This is a rod super, but 9 ins. in thickness, and the quantity must be compared with the standard rod. When taking off the quantities, the Quantity Surveyor would measure the 9-in. walls and take two-thirds of the total area into the Bill of Quantities for $1\frac{1}{2}$ brick walls, for the reason that a wall 9 ins. thick is two-thirds the thickness of a $13\frac{1}{2}$-in. wall. The previous nett total per rod (reduced) was 4290, and taking two-thirds of this gives a total of 2860 bricks, which, compared with the 2855 now calculated, shows a difference of 5 bricks only.

It will be noted therefore that the method of bonding and the thicknesses of walls makes very little difference in the actual number of bricks required per rod reduced.

Number of Bricks per Yard Super in 9-in. Walls (Four Courses to the Foot in Height).—This item does not often occur, but for comparative purposes the number of bricks is given. Dividing the last total of 2860 by $30\frac{1}{4}$ gives $94\frac{1}{2}$ as the number of bricks required for 1 yd. super 9 ins. thick. This must not be confused with the "Northern" and "Midland" Standard yards, which are described later.

Number of Bricks per Yard Cube.—The "Standard Method of Measurement" permits brickwork in walls exceeding $3\frac{1}{2}$ bricks in thickness to be given in yards cube. The number of bricks required can be calculated as previously described, or can be calculated upon the quantities given for the standard rod. A foot cube of brickwork is exactly $\frac{8}{9}$ ft. super of brickwork $1\frac{1}{2}$ bricks thick, and when reducing cube brickwork to standard rods, the Quantity Surveyor usually deducts one-ninth. A yard cube contains 27 cub. ft., deducting one-ninth gives 24 ft. super "reduced" brickwork, and as a standard rod of 272 ft. super contains 4290 bricks nett, by proportion it will be found that 24 ft. super reduced brickwork, or 1 yd. cube, requires $378\frac{1}{2}$ bricks. The usual allowances of course must be added.

Number of Bricks per Foot Super in Half-Brick Walls.—These are billed usually per foot super, but occasionally per yard super. Taking the number of bricks previously given for a wall of 272 ft. super, 9 ins. thick, viz. 2860 bricks, and dividing by 2, gives 1430 bricks for a half-brick wall 272 ft. super, which works out at approximately $5\frac{1}{4}$ bricks per foot super (actually 5·257). Usual allowances must be added.

Blue Bricks (also Bricks other than Standard Size).—It is important to remember that the previous calculations are based upon the standard or R.I.B.A. size of brick, but with bricks of different sizes fresh calculations are necessary. A typical blue Staffordshire brick, principally used for foundation work and factory construction, probably will be $8\frac{3}{4}'' \times 4\frac{1}{4}'' \times 3''$ (without joints), and $9'' \times 4\frac{1}{2}'' \times 3''$ with joints. It will be found that less bricks will be required per rod, and there is very little waste. Actually, about 4100 of the above bricks per rod are required, allowing 1 per cent. for waste (the actual figure found by arithmetic is 4097).

Mortar Required per Standard Rod.—With vertical joints $\frac{1}{4}$ in. in thickness and horizontal joints $\frac{5}{16}$ in. (R.I.B.A. standard), it will be found that a rod of brickwork $16\frac{1}{2}$ ft. in length, $16\frac{1}{2}$ ft. in height, and $13\frac{1}{2}$ ins. in thickness, will require the following, viz. :—

(*a*) $16\frac{1}{2}$ ft. of horizontal jointing $\frac{5}{16}$ in. in thickness and $13\frac{1}{2}$ ins. in depth, for 66 courses in height.
(*b*) $16\frac{1}{2}' \times 16\frac{1}{2}'$ of vertical jointing, $\frac{1}{4}$ in. thick, for internal portion of wall.
(*c*) $16\frac{1}{2}' \times 13\frac{1}{2}''$ of vertical jointing, $\frac{1}{4}$ in. thick, for 22 bricks in length.
(*d*) $16\frac{1}{2}' \times 9''$ of vertical jointing, $\frac{1}{4}$ in. thick, for 22 bricks in length.
(*e*) 4290 frogs, average size $6'' \times 2'' \times \frac{1}{8}''$.

If the above dimensions are "squared" in the usual manner, it will be found that 56 cub. ft. of mortar is required, or $2\frac{2}{27}$ yds. cube; but as a certain amount of mortar will be wasted, a total can be taken of $2\frac{1}{4}$ yds. cube per standard rod. It will be noticed that the above calculation is based upon bricks with one frog; bricks with two frogs naturally will require more mortar, and bricks with no frogs will require slightly less mortar.

Mortar Required for Pointing.—Facing bricks require extra mortar for pointing, and taking a standard rod as described, it will be found that 1635 ft. lineal of jointing is exposed, which at $\frac{1}{4}'' \times 1''$ (a usual allowance) gives 3 cub. ft. per rod.

Cost of Bricks.—Bricks are sold at a price per thousand, but before a price per rod can be calculated, it is necessary to ascertain the price delivered on site. As a typical case, we will asume Fletton bricks at £2 12s. per 1000 in trucks at railway station.

Detailed Cost of Bricks per 1000.—

	£	s.	d.
Fletton bricks, as quoted at railway station . .	2	12	0
Haulage, 3 tons, at 5s. 6d.	0	16	6
Unloading truck, 2 labourers, $\frac{1}{2}$ hour, at 2s. $6\frac{1}{2}$d. .	0	1	$3\frac{1}{4}$
Unloading to job, 2 labourers, 1 hour, at 2s. $6\frac{1}{2}$d. .	0	2	$6\frac{1}{2}$
	£3	12	$3\frac{3}{4}$

This is given simply as an example. It is necessary to work out the cost for every description of brick separately, and it is obvious that transport and carriage are important factors.

Bricks vary in weight, but Flettons work out at about 3 tons per 1000, and London Stocks slightly more; but for an accurate datum the exact weight of each class of brick should be obtained.

Labour per Rod.—It is very difficult to price labour for any trade, and for brickwork so many factors enter into the calculations that it is not remarkable that Estimating Surveyors differ in their estimates for this work. The output of different men over similar tasks varies considerably; the nature of the work; the state of the weather; the season of the year; the quality of the bricks and local circumstances all affect the time expended; but organisation can effect considerable saving if applied judiciously. Many calculations have been made upon the assumption that a bricklayer assisted by a labourer will lay a certain number of bricks per day, but with proper organisation it is sometimes possible to arrange for two labourers to assist three bricklayers, or perhaps one labourer to attend upon two bricklayers, and if this can be arranged it is obvious a saving can be effected, and a datum must be calculated for each separate circumstance.

In making calculations for labour, it should be noted that 9-in. walls will take less time per rod than 14-in. walls, although 9-in. walls with fair faces each side will naturally take longer to build. Walls over 14 ins. in thickness should not take so long in proportion as 14-in. walls, because thick walls are easier to erect. Brickwork executed in cement mortar takes somewhat longer time than brickwork executed in lime mortar.

Frequently comparison is made regarding the number of bricks laid per day at the present time, compared with the number of bricks laid per day several years ago, but the point so often overlooked by persons writing in the public press, and others taking part in discussions is that the present working day is shorter than formerly. The only reliable method of obtaining an accurate local datum for this item is to keep costs of several sections of work in progress, and to calculate the number of bricks laid *per hour*. In making such calculations it should be kept in mind that only the actual number of bricks laid in ordinary work must be noted, for any time spent upon laying and pointing facings, setting stoves, bedding and pointing frames, and all other items dealt with separately in a Bill of Quantities, must be deducted from the time actually spent in laying bricks.

In the calculations which follow it is assumed that a bricklayer, with the assistance of a labourer, will lay 63 bricks per hour (i.e. 500 bricks per day of 8 hours). Upon 9-in. walls, 75 bricks per hour should be possible, and if two labourers assist three bricklayers, or other details of organisation are arranged, the number of bricks laid will vary. Water will be required for wetting bricks, but this is dealt with in Chapter III. In the following costs it is assumed that one rod in lime mortar requires 68¼ hours, and in cement mortar 70 hours.

Cavity Walls.—The extra labour in forming cavity in hollow walls can be taken as 10 minutes for bricklayer and labourer for 11-in. walls, and 15 minutes bricklayer and labourer for 16-in. walls *per yard* super.

DETAILED COSTS PER ROD SUPER (REDUCED).

Brickwork in Flettons in Lime Mortar (1 *to* 3).

	£	s.	d.
4333 Fletton bricks, delivered, at £3 12s. 4d. per 1000	15	13	5
2¼ cube yds. of mortar (see Chapter II.), at £1 6s. 9d.	3	0	2¼
Scaffold (as detailed in Chapter II.)	1	2	10
Bricklayer and labourer, 68¼ hours, at 2s. 11¼d.	10	0	5¾
Price per rod	29	16	11

Brickwork in Flettons in Cement Mortar (1 *to* 3).

	£	s.	d.
Bricks and scaffold, as in last item	16	16	3
2¼ cube yds. of cement mortar (see Chapter II.), at £1 18s. 8d.	4		0
Bricklayer and labourer, 70 hours, at 2s. 11¼d.	10		7½
Price per rod	31	8	10½

Brickwork in London Stocks in Lime Mortar (1 *to* 3).—London Stocks at £4 10s. per 1000 in trucks, or £5 10s. 4d. per 1000 delivered and unloaded (see detail earlier for Flettons). One labourer attending upon two bricklayers.

	£	s.	d.
4376 bricks, at £5 10s. 4d. per 1000	24	2	
2¼ cube yds. of mortar, at £1 6s. 9d.	3	0	
Scaffold, as detailed previously	1	2	10
Bricklayer, 68¼ hours, at 1s. 8d.	5	13	9
Labourer, 34¼ hours, at 1s. 3¾d.	2	3	6¼
Price per rod	36	3	1¼

Brickwork in London Stocks in Cement Mortar (1 *to* 3).—Materials as last item, and one labourer to attend upon two bricklayers.

Bricks and scaffold, as last item	£25	5	7¾
2¼ cube yds. of cement mortar as previous items, at £1 18s. 8d.	4	7	0
Bricklayer, 70 hours, at 1s. 8d.	5	16	8
Labourer, 35 hours, at 1s. 3¼d.	2	4	5¾
Price per rod	£37	13	9½

Brickwork in Fletton Bricks in Cement Mortar (1 *to* 3) *in 9-in. Walls*, with bricks grooved for plastering.—Two labourers to attend upon three bricklayers.

4333 Flettons, at £3 12s. 4d. as before	£15	13	5
Extra for grooves—maker's charge 2s. per 1000	0	8	8
2¼ cube yds. cement mortar, at £1 18s. 8d.	4	7	0
Scaffold—two-thirds of previous cost	0	15	2¾
Bricklayer, 63½ hours, at 1s. 8d.	5	5	10
Labourer, 42½ hours, at 1s. 3¼d.	2	14	0
Price per rod	£29	4	1¾

Brickwork in Local Common Bricks (allowing 5 per cent. for Waste) in Lime Mortar (1 *to* 3) *in Backings to Stone Dressings.*—One labourer to attend upon two bricklayers. Ten per cent. added to labour for bonding into masonry.

4505 bricks, at £3 10s. per 1000	£15	15	4
2¼ cube yds. lime mortar, as before, at £1 6s. 9d.	3	0	2¼
Scaffold, as detailed	1	2	10
Bricklayer, 75 hours, at 1s. 8d.	6	5	0
Labourer, 37½ hours, at 1s. 3¼d.	2	7	7¾
Price per rod	£28	11	0

Brickwork in Staffordshire Blue Bricks in Cement Mortar (1 *to* 3) in pier foundations.—No scaffold necessary; 4100 bricks and 2 yds. cube of cement mortar required per rod. Bricks at £8 10s. per 1000 in trucks and £9 10s. per 1000 delivered and unloaded.

4100 blue bricks, at £9 10s. per 1000	£38	19	0
2⅛ cube yds. of cement mortar (1 to 2), at £2 1s.	4	7	1½
Bricklayer and labourer, 84 hours, at 2s. 11½d.	12	6	9
Price per rod	£55	12	10½

Brickwork in London Stocks in Half-brick Walls in Cement Mortar (1 *to* 3).—One labourer to attend upon two bricklayers.

Price per rod, as detailed previously	£37	13	
Add 10 per cent. to labour only for forming fair faces	0	16	1½
	£38	9	11

The above is for a wall 1½ bricks thick, and the total must be divided by 3 to obtain the cost of a half-brick wall, but as this item is usually priced per foot super, the total must also be divided by 272, which gives *Price per foot super*, 11¼d.

Brickwork in London Stocks in Lime Mortar (1 *to* 3) *in Cavity Walls* of 4½-in. outer and 9-in. inner walls, with 2½-in. cavity, and galvanised iron wall ties spaced four per yard super.—One labourer to attend upon two bricklayers.

	£	s.	d.
Cost per rod for 14-in. brick wall, as previously described	36	3	1¼
Extra labour in forming cavity :—			
Bricklayer, 7½ hours, at 1s. 8d.	0	12	6
Labourer, 3¾ hours, at 1s. 3½d.	0	4	9¼
Extra waste of mortar (about 10 per cent.), say ½ yd. cube, at £1 6s. 9d.	0	6	8½
120 wall ties = ½ cwt., at 28s.	0	14	0
Price per rod	38	1	0¼

North of England Practice.—In the year 1919 the Royal Institute of British Architects, in consultation with the Brickmakers' Association, fixed a special Standard for the Northern Counties of England. The dimensions agree with the 1904 Standard, except as follows, viz. : In height, four courses of bricks and four joints are to measure 13 ins. This will give either $\frac{5}{16}$ in. or $\frac{3}{8}$ in. as thickness for the horizontal joints, in accordance with the sizes of the bricks, which vary in different districts ; as a general rule, Northern bricks are deeper than Southern bricks. The 1919 Standard applies to the following counties : Cumberland, Durham, Lancashire, Northumberland, Westmorland, and Yorkshire.

Number of Bricks per Yard Super in 9-in. Walls (*Northern Bricks*).—To calculate the number of bricks required for a standard yard super, 9 ins. thick, it is advisable to assume a typical wall as given in the calculations in Chapter V. A wall 6 yds. in length and 5 yds. in height, will give 30 yds. super, which is so near the area of a standard rod as to be suitable for comparative purposes, and gives an easy figure to be used for dividing into the final total.

If the length of 18 ft. (6 yds.) is divided by 9¼ ins. for the stretcher course, it will be found that 23½ bricks are required, and doubling this for both sides of the wall gives a total of 47 bricks per course. To find the number of courses, the

height of 15 ft. should be divided by 13 ins. and multiplied by 4, which gives the number of courses as 56, and this multiplied by 47 (the number of bricks contained in a course) gives 2632 bricks nett. About 14 bricks will be lost in forming closers, and an allowance must be added for waste in accordance with the quality of bricks used, as described in the previous calculation. As a general rule, it will be found that Northern bricks are fairly hard, and an allowance of $2\frac{1}{2}$ per cent. for waste should be sufficient, so for the above wall 2712 bricks are required. It is interesting to note that a wall of equal dimensions, if built in the Southern method of four courses to the foot, would require a nett total of 2820 bricks. Dividing the total of 2712 by 30 gives the total number of bricks per yard super as slightly more than 90 (say $90\frac{1}{2}$).

Mortar Required per Standard Yard (*Northern Practice*). —With vertical joints of $\frac{1}{4}$ in., and horizontal joints of $\frac{5}{16}$ in., it will be found that the following material is required for a wall 18′ × 15′ × 9″, viz. :—

(*a*) 18 ft. lineal of horizontal jointing, $\frac{5}{16}$ in. in thickness, 9 ins. deep, for 56 bricks in height.

(*b*) 15 ft. lineal of vertical jointing, $\frac{1}{4}$ in. in thickness, and 9 ins. deep, for 23 bricks in length.

(*c*) $7\frac{1}{2}$ ft. lineal (half the above) vertical jointing, $\frac{1}{4}$ in. in thickness and 9 ins. deep, for 23 bricks in length, extra for header course.

(*d*) 2646 frogs, say 6″ × 2″ × $\frac{1}{8}$″.

The above dimensions will give the quantity of mortar required for a wall actually 9 ins. in depth, but if the brickwork is to be built in greater thickness, naturally more mortar will be required for bonding the 9 ins. already taken into the other thickness, and a fair allowance would be to take half the quantity of this internal jointing and add it to the above totals, viz. :—

(*e*) One-half of 18′ × 15′ × $\frac{1}{4}$″ vertical jointing.

The whole of the above will be found to contain $32\frac{1}{2}$ ft. cube, and allowing for waste will give 33 ft. cube for the typical wall. Dividing by 30 gives the total per yard super as $1\frac{1}{10}$ ft. cube.

DETAILED COSTS PER YARD SUPER REDUCED.

Brickwork in Northern Common Bricks in Lime Mortar (1 *to* 3), with bricks at £5 per 1000 delivered.

	£	s.	d.
90½ Stock bricks, at £5 per 1000	0	9	0½
1 1/10 ft. cube of lime mortar, at £1 6s. 9d. per yard	0	1	1
Scaffold, as detailed in Chapter II., but divided by 30½, and less one-third	0	0	6
Bricklayer and labourer (at 63 bricks per hour), 1⅘ hours, at 2s. 11½d.	0	4	2
Price per yard super	£0	14	9½

Brickwork in Northern Common Bricks as before, but in Cement Mortar (1 *to* 3).

	£	s.	d.
Bricks and scaffold, as above	£0	9	6½
1 1/10 ft. cube cement mortar, at £1 18s. 8d. per yard	0	1	7
Bricklayer and labourer, 1⅘ hours, at 2s. 11½d.	0	4	7½
Price per yard super	£0	15	9¾

Brickwork in Lime Mortar in Northern Common Bricks as before (1 *to* 3).—One labourer to attend upon two bricklayers.

	£	s.	d.
Bricks, mortar, and scaffold, as previous item	£0	10	7½
Bricklayer, 1⅘ hours, at 1s. 8d.	0	2	4½
Labourer, ⅘ hours, at 1s. 3¼d.	0	0	11
Price per yard super	£0	13	11

Brickwork in Cement Mortar in Northern Common Bricks as last Item (1 *to* 3).—One labourer to attend upon two bricklayers.

	£	s.	d.
Bricks, mortar, and scaffold, as former item	£0	11	1½
Bricklayer and labourer, as last item, plus 10 per cent.	0	3	7½
Price per yard super	£0	14	9

Midland Practice.—In the Midlands often it is found that brickwork is specified as seven courses to 2 ft. in height. This originally was due to a difference in the size of bricks compared to London bricks, but as Fletton bricks, and bricks of a similar size, are used in the Midlands, if seven courses equal 2 ft. the horizontal joints are thicker than in the South of England. It is now possible to obtain "Flettons" a full 3 inches in height.

Number of Bricks per Yard Super in 9-in. Walls (*Standard Bricks*).—If a typical wall is taken, in a similar manner to the wall described in this chapter for Northern bricks, it will be

found that the same number of bricks are required per course, but the number of courses will be less. If the height of 15 ft. is divided by 2 and multiplied by 7, the number of courses will be 52½. This figure, multiplied by 47, gives 246½ bricks nett, but adding 12½ bricks for loss in forming closers, and 1 per cent. for waste (25 bricks), gives a total of 2505 bricks, and this, divided by 30, gives the number of bricks per yard super as 83½. Hard "commons," allowing about 2 per cent. for waste, would give a total of 84⅓ bricks per yard; and local "commons," allowing 5 per cent. for waste, would give 87 bricks per yard.

Mortar Required per Yard Super (*Midland Practice*).—This can be calculated in a similar manner as described for Northern Standard Yards, but if the horizontal joints are thicker (which is usual), the additional amount of mortar required would bring the amount up to $1\frac{7}{10}$ ft. cube per yard super.

Detailed Costs per Yard Super.

Brickwork in Ordinary Flettons in Lime Mortar (1 *to* 3), per yard super in 9-in. walls, seven courses to equal 2 ft.

	£	s.	d.
83½ Fletton bricks, delivered, at £3 12s. 4d. per 1000	£0	6	0½
$1\frac{7}{10}$ ft. cube lime mortar (see Chapter II.), at £1 6s. 9d. per yard	0	1	8¼
Scaffold, as detailed in Chapter II., but divided by 30½, and less one-third	0	0	6
Bricklayer and labourer (63 bricks per hour), 1⅜ hours, at 2s. 11½d.	0	4	2¼
Price per yard super	£0	12	5

Brickwork in Local "Commons" in Cement Mortar (1 *to* 3), in 9-in. walls as above, with Standard Bricks, seven courses to equal 2 ft.

	£	s.	d.
87 common bricks, delivered, at £3 per 1000	£0	5	2¼
$1\frac{7}{10}$ ft. cube cement mortar (see Chapter II.), at £1 18s. 8d. per yard	0	2	5¼
Scaffold, as above	0	0	6
Bricklayer and labourer as last item, but plus 10 per cent.		4	7¼
Price per yard super	£0	12	9

Imported Bricks.—Bricks from abroad are occasionally used, being cheap in price, but as the size is smaller than that of an English brick, more mortar is required, and although

the number laid per day will be about equal to the number of English bricks, the saving in cost may not be so great as at first anticipated, especially in bonding to English facings. Enquiries therefore should be made regarding the sizes of foreign bricks before attempting to price work for which they are likely to be used. Other items as detailed for Southern methods can be worked out to conform to data given for Northern and Midland methods.

Brickwork : General Items.

Core and Parge Flues.—These are per number, but the approximate length of flue must be obtained. Allow 10 ft. per hour bricklayer and labourer, and for parging material, 2d. per foot, and make no deduction for bricks not used in flue, as many will be wasted in bonding.

Items Priced per Foot Run.—Rough cutting : Allow 3 ft. per hour, and a quarter of a brick per foot for waste.

Fair cutting : Double the above allowance.

Rake out and point flashings : Allow 10 ft. per hour and 1d. material.

Rake out and point flashings (stepped) : Allow 8 ft. per hour and 1d. material.

Cement fillets : Allow 9 ft. per hour and 2d. material.

Tile creasing : Allow 5 tiles per foot ; cement, 4d. ; and bricklayer and labourer, 10 ft. per hour.

Brick on edge copings or sills : Allow 4 bricks per foot ; mortar, 1d. ; and bricklayer and labourer, 10 minutes.

Bed and point frames : Labour, 4 minutes, and mortar, ½ ft. cube per foot run.

Items Priced per Number.—Bed and point frames (large) : Labour, 2 hours ; mortar, $\frac{1}{25}$ yd. cube.

Setting stoves : Labour, 4 hours ; mortar, $\frac{1}{10}$ yd. ; and 10 extra bricks.

Setting kitcheners : Labour, 8 to 16 hours ; mortar, ⅛ yd. ; 40 extra bricks ; and for fireclay allow, say 5s.

Setting chimney-pots : Labour, ½ hour ; cement, $\frac{1}{50}$ yd. cube ; and add cost of pot and carriage.

Fixing small steel casements : Labour, ½ hour.

Fixing chimney-bars : Labour, 10 minutes.

Cutting holes and making good for soil or similar pipes : Labour, 1 hour ; material, 1s. 6d.

Cutting holes and making good for ordinary plumbing pipes: Labour, ½ hour; material, 1s.

Setting washing boilers: Labour, 7 hours; 125 extra bricks and, say, 30 fire bricks; and ⅛ yd. cube mortar.

Setting air bricks: Labour, 5 minutes each brick, plus cost of air bricks and extra mortar (worth 6d. for setting two bricks and forming cavity).

Oversailing—Allow for labour 2 minutes per foot per course.

Chasing for Pipes.—Allow for labour 10 minutes per foot.

The above are typical items, and if the same are studied carefully the student should have no difficulty in adapting them to suit other items and variations thereon.

Slate Damp-proof Course.—Second-hand slates cost about £19 per 1000. Allow two slates per foot super, say 8d.; cement, 3d.; and one-tenth of an hour for bricklayer and labourer, 3¾d.; the cost per foot super works out at about 1s. 2¾d.

Cavity Walls.—Prices can be worked up from the datum given for rod brickwork, but these walls are now priced per foot super, giving thickness of inner and outer walls. To the previous calculations the following adjustments must be made:—

For 11-in. cavity walls add for bricklayer and labourer, per yard super, 10 minutes.

For 16-in. cavity walls, add for bricklayer and labourer, per yard super, 15 minutes.

The cost of wall ties must be added, and if four per yard super are specified (and this is usual), the price can be calculated by allowing 240 to the cwt. The present price is about 28s. per cwt.

Pointing.—If the scaffold is not removed, allow per yard super for weather jointing, ¾ hour for bricklayer and labourer, and $\frac{1}{10}$ ft. cube of mortar. If in cement, add 10 per cent, to the time taken, and if scaffold has to be erected, this must be calculated as shown earlier.

For raking out joints and pointing, allow 1½ hours for labour and ¼ ft. cube of mortar.

Breeze Concrete Partition Slabs.—The labour erecting 2-in. blocks and 3-in. blocks is about the same in each case, i.e. bricklayer and labourer, ¾ hour per yard super. Slabs 4 ins. thick are worth about 1 hour per yard super.

A yard super of 3-in. slabbing requires one-sixth of a foot cube of mortar; 2-in. slabs take two-thirds of this quantity, and 4-in. slabs one-third more than 3-in.

Detailed Cost per Yard Super (assuming no scaffold is required), *Breeze Slab Walls in Cement Mortar* (1 *to* 3).—

	£	s.	d.
Breeze concrete slabs, 3 ins. thick, delivered, per yard super, 2s.	0	2	0
Waste, 2½ per cent.	0	0	0½
Unloading and stacking—2 labourers, 10 mins. = ⅓ hour, at 2s. 6½d.	0	0	10
⅙ ft. cube mortar (1 to 3), at £1 18s. 8d. *per yard cube*	0	0	3
Bricklayer and labourer, ⅔ hour, at 2s. 11½d.	0	2	2½
Price per yard super	0	5	4½

Labour and Waste Items on Breeze Slabs.—

Pin up to Soffits, etc. (per foot run).

Allow $\frac{1}{18}$ of 1 yd. super of slabbing for waste and extra labour 5 minutes.

Pin up to Ditto, but Raking (per foot run).—

Allow ⅛ of 1 yd. super for waste and extra labour 5 minutes.

Straight Cutting.—Allow as described for "pin up."

Raking Cutting.—Allow as described for "pin up but raking."

Extra Labour in Forming Opening, Including Welsh Arch, (per No.)—Allow 1 yd. super for waste and 1½ hours for labour.

Terra-cotta Partition Blocks.—These are used because they are lighter than concrete slabs. Blocks 2 ins. thick cost 3s. per yard super, and 3 ins. thick 3s. 9d. per yard super.

The labour erecting 2-in. blocks and 3-in. blocks is about the same in each case, i.e. bricklayer and labourer 40 minutes per yard super. Blocks 4 ins. thick are worth about ¾ hour per yard super.

Detailed Cost per Yard Super (assuming no scaffold required).—

2-in. Terra-cotta Slab Walls in Cement Mortar (1 *to* 3).—

	£	s.	d.
Terra-cotta slab walls, 3 ins. thick, delivered, 3s. per yard super	0		
Waste, 2½ per cent.	0		
Unloading and stacking—2 labourers, 5 mins. = ⅛ hour, at 2s. 6½d.	0	0	5
⅙ ft. cube mortar (1 to 3), at £1 18s. 8d. per yard cube	0	0	3
Bricklayer and labourer, 40 mins., at 2s. 11½d. per hour	1	11½	
Price per yard super	0	5	8½

The quantity of mortar required is about the same as for breeze slabs, for although the joints are neater, there are more of them.

Labour and Waste Items.—

These can be taken at the same rates as those given for breeze slabs.

Brickwork : Facings.

Facings.—Facing bricks are priced per foot super, "extra only" over the cost of ordinary brickwork; it is necessary therefore to know the extra cost of the facing bricks themselves over the ordinary bricks per thousand. In the calculations for the number of bricks required per rod super in English bond, it will be noticed that the number of courses in height is 66, and the number of bricks required in the stretcher course is 21½, which gives 43 for the header courses. The average of 21½ and 43 is 32¼, and if this figure is multiplied by 66 the number of bricks appearing on the face of a standard rod will be obtained. Adding to this total (2128½) 8¼ bricks for closers, and 2 per cent. for waste, gives a total per rod of 2179. The number of facing bricks required varies with the bond: the net number of facing bricks required per yard super in Flemish bond is 60, but a yard super of English bond requires 72 bricks, or 20 er cent. more. This is important if expensive bricks are used. P"Rustic" Fletton facings can now be obtained in sizes suitable for bonding with Northern and Midland "commons."

Detailed Cost of Facings per Foot Super. "Extra Only" (say Rustic Flettons).—

2179 facing bricks, at extra cost of £1 1s. 3d. per 1000	£2	6	3¾
3 ft. cube of mortar, at £1 18s. 8d. per yard cube .	0	4	3¾
Bricklayer and labourer, extra time, 20 hours, at 2s. 11¼d.	2	18	9
Cost per rod	£5	9	4½

Dividing by 272 gives the price per foot super, extra only, as 4¾d.

Glazed Brickwork.—This is measured in a similar manner to ordinary facings, but there are extras for angles, squints, and chamfers, as these bricks will require a glaze upon more than one face. The makers will quote the extra price, which works out at about £8 more per thousand. These extra items are priced per foot run, and if the work is gauged four courses

to the foot, then 4 bricks are required per foot. There is no extra labour or mortar for the items priced per foot run. It is very important to ascertain the bond as this will affect the price seriously in this case.

Narrow Widths.—Facings and glazed brickwork in narrow widths, 9 ins. wide and under, are kept separate under the "Standard Method of Measurement," and priced per foot run. The cost per foot can be obtained by proportionate methods from the price per foot super, but being "in small quantities," an extra allowance should be made, say 5 per cent.

Gauged Arches.—These are priced per foot super, "Extra only," and to obtain the price, a typical arch must be worked out in detail. For an opening 3 ft. wide, 25 special facing bricks would be required and would displace 12 ordinary bricks.

	£	s.	d.
25 special facing bricks, at £5 10s. 4d. per 1000	0	2	9½
Less, 12 ordinary Flettons, at £3 12s. 4d.	0	0	10½
	0	1	11½
Bricklayer and labourer (including rubbing bricks), 4 hours, at 2s. 11½d.	0	11	9
Jointing material (say)	0	0	9
	0	14	5½

The above arch would contain 3 ft. super, therefore dividing by 3 gives the price of 4s. 10d. per foot super "extra only." Other arches can be calculated by proportionate methods in a similar manner.

Rough Axed Arches.—These are calculated in a similar way to the gauged arches, but only 10 bricks need be allowed for waste, and for bricklayer and labourer 2 hours should be sufficient. This item is priced per foot super.

Rough Relieving Arches.—These are numbered "extra only," and are calculated in a similar manner to gauged arches, and for a typical 3 ft. opening allow 10 extra bricks and 1¼ hours bricklayer and labourer; there will be no extra mortar. An arch for a 3-ft. opening worked out as above would cost (on the previous datum) about 5s. 6d., and having worked out one typical case, others of different sizes can be calculated by proportionate methods. An arch double the above size will cost twice as much, whilst one half the size will cost half as much, and so on.

CHAPTER VI.

MASON AND PAVIOR.

MASON.

THIS was considered the most difficult trade to price with accuracy, but the 1935 Standard Method of Measurement has made the work easier. In many establishments the work is sub-let, and consequently the sub-contractor prices the bill. Frequently the sub-contractor gives a lump sum price for the whole of the mason's work, and it is very disappointing to the Quantity Surveyor, who perhaps has " taken off " the stone, to find that all his work has apparently been wasted. The masonry contractor, however, prefers to know the quantities, as it enables him to visualise the job as a whole.

The variation as regards hardness in different kinds of stone is so great that each local stone must be considered separately. Portland stone and granite naturally are expensive to work, but Bath stone and others of similar quality are not so difficult. Certain stones, particularly those from Bath and Portland, can be obtained now from the quarry already worked, including all mouldings ; in these circumstances the pricing of the bill is not difficult.

Waste.—The dimensions given in a Bill of Quantities are presumed to have allowed for waste, as the Quantity Surveyor, in " taking off " his dimensions takes the sizes of the blocks of stone, out of which it is assumed the finished block will be cut, and adds the thickness of the mortar beds and joints, but frequently masons add a further allowance.

Freight and Weight.—This is an important item, and the distance of the work from the railway station may affect the price of the stone considerably. The sizes of the blocks require careful consideration, for it must be borne in mind that large blocks are difficult to handle. The weights of the principal stones per foot cube are as follows : Granite, 160 to 170 lbs. ;

York stone, 140 to 150 lbs.; Darley Dale, 148 lbs.; Craigleith, 145 lbs.; Mansfield, 140 lbs.; Bath and Portland, 135 lbs.; but the railway companies' charges are based upon a computed weight of 16 cub. ft. to the ton.

Handling.—A considerable amount of time is spent in unloading and stacking the stone, selecting suitable blocks, conveying to the banker and reloading for delivery to the job, apart from labour on the site. The only way to arrive at a price for this is to keep an accurate cost of all time spent in this way for a given period, say twelve months, and then to calculate the actual output of stone from the yard for the same period. Dividing the total cost by the total number of feet cube of stone handled will give the price per foot cube, and this can then be added to the cost of the stone.

Sawing.—Sawing into suitable blocks can be calculated in a similar manner, as described for handling. It is usual for the conversion of stone into useful sizes to be done by machinery, and naturally the more modern plant available the less will be the cost of sawing. As one saw-cut produces two stones, each stone, therefore, must bear half the cost of sawing for each face. The following prices have been given the writer, and are used solely for the purpose of compiling data :—

Cost of Labour and Machinery: Sawing.—The following prices are per foot super per cut, viz. :—

Granite.	Darley Dale.	York.	Portland.	Bath.	Bath (Box Ground).
10½	8½	7½	7½	3	3½

York stone frequently is sawn at the quarry :—

Cost of Stone.—The following recent London prices are appended for comparative purposes, and to enable typical examples to be constructed; in actual practice quotations for stone would be obtained from the quarry :—

Portland (basebed)	4s. 8d.	per foot cube.
,, (Whitbed)	4s. 5d.	,, ,,
Bath	2s. 10d.	,, ,,
York stone, 6 ins. thick	6s. 0d.	,, ,,
,, ,, 4 ,, ,,	3s. 2d.	,, ,,
,, ,, 3 ,, ,,	2s. 8d.	,, ,,

These prices do not include cartage from the railway station to the works and this depends upon distance. It will

be seen that this is expensive, for in the example given later on ashlar work, the cost of cartage amounts to nearly half the cost of the stone. With dressings the cost is higher in proportion.

Labours at the Banker.—Before the stone can be fixed in position, it must be worked at the mason's yard, and the following table gives the time expended per foot super for the usual labours for the different classes of stone.

	Granite.	Darley Dale.	York.	Portland.	Bath (Box Ground).	Bath.
Labours, in minutes, per foot super—						
Labour to back .	27	20	18	15	6	5
Beds and joints .	56	38	35	30	12	10
Sunk ditto . .	80	60	50	45	18	15
Labours, in hours, per foot super—						
Plain face . .	$2\frac{3}{4}$	2	2	$1\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
Sunk ,, . .	$3\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{4}$	2	$\frac{3}{4}$	$\frac{3}{4}$
Circular face . .	4	$2\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{1}{4}$	1	$\frac{3}{4}$
,, columns .	$5\frac{1}{2}$	$4\frac{1}{2}$	4	3	$1\frac{1}{4}$	1
Moulded work . .	$7\frac{1}{4}$	$5\frac{1}{2}$	$4\frac{1}{4}$	4	$1\frac{3}{4}$	$1\frac{1}{2}$
Circular circlr. work .	9	$6\frac{1}{2}$	$5\frac{1}{2}$	5	$2\frac{1}{4}$	2
,, mould. work	$9\frac{3}{4}$	$7\frac{1}{2}$	$7\frac{1}{4}$	$5\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{4}$

With masons wages at 1s. 8d. per hour, the costs work out as follows, viz. :—

Labours per foot super.	Granite.	Darley Dale.	York.	Portland.	Bath (Box Ground).	Bath (Monk's Park).
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Labour to back .	0 9	0 $6\frac{2}{3}$	0 6	0 5	0 2	0 $1\frac{2}{3}$
Beds and joints .	1 $6\frac{2}{3}$	1 $0\frac{2}{3}$	0 $11\frac{2}{3}$	0 10	0 4	0 $3\frac{1}{3}$
Sunk ditto .	2 $2\frac{2}{3}$	1 8	1 $4\frac{2}{3}$	1 3	0 6	0 5
Plain face .	4 7	3 4	3 4	2 6	0 10	0 10
Sunk ,, .	5 10	4 2	3 9	3 4	1 3	1 3
Circular face .	6 8	4 7	4 2	3 9	1 8	1 3
,, columns	9 2	7 1	6 8	5 0	2 1	1 8
Moulded work .	12 1	8 9	7 1	6 8	2 11	2 6
Circular circular work . .	15 0	10 10	9 2	8 4	3 9	3 4
Circular moulded work . .	16 3	12 6	12 1	9 2	4 2	3 9

Labours.—In accordance with the new Standard Method of Measurement, stonework generally is to be measured and given to include all labours; much of the work is per foot cube, but certain items, such as small cornices and string courses, sills, copings, mullions and transomes, are to be given by the foot run.

Ashlar work is given by the foot super.

Detailed Prices.—For the purpose of preparing detailed prices, the mason's trade is sub-divided into three divisions, i.e. walling, ashlar work, and dressings. Walling is practically a separate trade; ashlar work consists of stone facings, or walls constructed entirely of stone; and dressings are usually separate blocks, or detached portions of work, or facings in a building constructed principally of brickwork, or of stone rubble.

Stone Walls.

It is possible to give a few examples only, as local stones differ considerably. Walls exceeding 18 ins. in thickness are billed per yard cube, but walls 18 ins. and under in thickness, per yard super; the prices for the latter items can be obtained by comparison with the former.

Uncoursed Rubble Walls in Lime Mortar (1 to 3).

	£	s.	d.
1½ yds. of rubble, at 14s. 10d. per yd. . .	1	2	3
Lime mortar, ¼ yd., at £1 6s. 9d. . . .	0	8	11
Mason, 6 hours, at 1s. 8d.	0	10	0
Labourer, 3 hours, at 1s. 3½d. . . .	0	3	9½
Labour—unloading stone, 1 hour, at 1s. 3½d.	0	1	3½
Price per yard cube . . .	£2	6	3

Coursed Rubble Walls in Lime Mortar (1 to 3).

	£	s.	d.
1¾ yds. of rubble, at 14s. 10d. per yd. . .	1	5	11½
Lime mortar, ¼ yd. cube, at £1 6s. 9d. . .	0	6	8½
Mason, 12 hours, at 1s. 8d.	1	0	0
Labourer, 6 hours, at 1s. 3½d. . . .	0	7	7½
Labour—unloading stone, 1 hour, at 1s. 3½d. .	0	1	3½
Price per yard cube	£3		6½

In the last two examples it has been assumed that one labourer can attend upon two wallers. To unload the stone would take two labourers half an hour each.

Flint Facings.—Flints are sold by the ton, and 1 ton of whole flints will face 3½ yds. super of wall, and if "knapped," i.e. split to form two faces, will face 5 yds. super.

Ashlar Work.

Ashlar work is priced per foot super to include all labours, and usually consists of facings to buildings constructed of brick or other stone than the facings.

Stone hoisted above 40 ft. has to be kept separate from other stone.

Ashlar work will require scaffolding as detailed in Chapter II.

For a typical example, a frontage is assumed 60 ft. long and 40 ft. high, which works out at 2400 ft. super. The mason fixing the stone receives 1d. above the ordinary rate, and this has been added.

Detailed Cost.—

Portland Stone in Ashlar Work *in blocks averaging 3 ft. long, 1 ft. 3 ins. in height, and average bed 7 ins. as facings to brickwork, bedded and jointed in special mortar composed of one part of grey stone lime to one part of stone dust.*

	£	s.	d.
Portland stone, 1400 ft. cube, at 4s. 6d.	315	0	0
Waste, 2½ per cent.	7	17	6
Clearing trucks and cartage, 88 tons, at 30s.	132	0	0
Rough sawing, 3987 ft. super, at 7½d.	124	11	11
Labours at the banker, viz.:—			
Labour to back (nil, as stone is already sawn)	0	0	0
Labour to beads, 1120 ft. super, at 10d.	46	13	4
Labour to joints, 467 ft. super, at 10d.	19	9	2
Labour to plain face, 2400 ft. super, at 2s. 6d.	300	0	0
Hoisting (at ⅓ hour per ft. cube), 467 hours, at 1s. 3½d.	29	13	6
Fixing, mason and labourer, 350 hours, at 3s. 0½d.	52	17	3
Special mortar (at ¼ ft. cube per foot cube of stone) = 8 yds., at £1 10s. 8d.	12	5	4
Use of scaffold, 2400 ft. super, at 2d.	20	0	0
Total cost	£1060	8	0

Dividing the above by 2400 gives the price per foot super of 8s. 10d.

The special mortar and the scaffolding are analysed in Chapter II., and the labours at the banker are taken from the previous tables.

At the time of writing, ashlar work of an average bed of 7 ins. is quoted by the quarry owners as 7s. 2d. per foot super for Bath stone, and 8s. 11d. per foot super for Portland stone fixed complete.

Stone Dressings.

Detailed Costs of Dressings.—

String Course in Bath Stone, 1 ft. 10½ ins. by 1 ft. deep, projecting 9 ins. beyond face of brickwork, with weathered top and moulded to detail. (A stone is taken 3 ft. long as an example.)

	£	s.	d.
Bath stone, 6 ft. cube, at 5s. 6d.	1	13	0
Waste, 5 per cent.	0		8
Rough sawing, 22 ft. super, at 1½d. (half cost)	0		9
Labours at banker :—			
3 ft. super, labour to back, at 1¾d.	0		5
3 ft. 6 ins. super, labour to bed, at 3½d.	0		0
2 ft. super, labour to joints, at 3½d.	0		7
2 ft. 6 ins. super, plain face, at 10d.	0		1
3 ft. super, moulded work, 2s. 6d.	0		6
3 ft. run, 2-in. margin, at 1¾d.	0		5
Hoisting, 2 labourers, ½ hour, at 2s. 6½d.	0		3¼
Fixing, mason and labourer, 2 hours, at 3s. 0½d.	0		0½
Special mortar, ½ ft. cube, at £1 10s. 8d. per yard	0		
Total cost	£2	17	3¾

Dividing by 6 gives the price per foot cube of 9s. 6½d.

At the time of writing, cornices and string courses of 12-in. girth are quoted at 7s. 7d. for Bath stone, and 16s. for Portland stone per foot run fixed on job.

Key Block in Portland Stone, 1′ 3″ × 1′ 2″ × 1′ 6″, *with circular head and hollow soffit, and fixed in brick arch.*

	£	s.	d.
Portland stone, 2 ft. 3 ins. cube, at 7s. 6d.	0	16	10½
Waste on ditto, 10 per cent.	0	1	8
Rough sawing, 10 ft. 4 ins. super, at 3¾d. (half cost)	0	3	2¾
Labours at banker :—			
3 ft. 11 ins. super sunk joint, at 1s. 3d.	0	4	11
3 ft. 10 ins. ,, plain face, at 2s. 6d.	0	9	7
2 ft. 10 ins. ,, plain circular work, at 3s. 9d.	0	10	7½
Hoisting, 2 labourers, 10 minutes, at 2s. 6½d.	0	0	5
Fixing, mason and labourer, ¾ hour, at 3s. 0½d.	0	2	3¼
Special mortar, ⅛ ft. cube, at £1 10s. 8d. per yard	0	0	2¼
Price for the block	£2	9	9¼

This is equivalent to £1 2s. 2d. per foot cube, but in making comparisons it must be noted that this is a circular headed block and fixed in an isolated position.

York Stone Sills.—These are priced per foot run, but the stone itself is sold per foot super and the price varies for different thicknesses. In the following costs it is assumed that the bricklayer will fix. The mortar used for this stone is ordinary cement mortar.

Detailed Cost.—

York Stone Sill out of 11″ × 4″ (a stone 4′ in length will be assumed).

	£	s.	d.
4 ft. super sawn York stone, at 3s. 2d.	0	12	
Waste, 7½ per cent.	0	0	10¾
Rough sawing, sides and edges only, 3 ft. 4 ins super, at 7½d.	0	2	1
Plain face, 1 ft. 5 ins. super, at 3s. 4d.	0	4	8½
Sunk face, 3 ft. super, at 3s. 9d. .	0	11	3
Hoisting, 2 labourers, 5 minutes, at 2s. 6½d.	0	0	2½
Fixing, bricklayer and labourer, ½ hour, at 2s. 11¼d	0	1	5½
Cement mortar, ⅛ ft. cube, at £1 18s. 8d. per yd.	0	0	2½
Total cost	£1	13	5¾

Dividing by 4 gives the price per foot run of 8s. 4½d.

In connection with the sill there would be an item "No. 2 stools and returned ends." These are worth half an hour each of mason's time.

York Stone Coping, 13 ins. wide with saddle-back top and 3-in. rubbed edges twice throated and bedded in cement mortar. This item is priced per foot run, and for a typical example a length of 3 ft. is taken. It would be necessary for the block to be 4 ins. in thickness, so that the weathered faces can be worked :—

	£	s.	d.
3 ft. 3 ins. super York stone, at 3s. 2d. . . .	£0	10	3½
Waste on ditto, 5 per cent.	0	0	6¼
Rough sawing, sides and edges only, 2 ft. 8 ins. super, at 3¾d.	0	0	9¼
Sunk face, 4 ft. super, at 3s. 9d.	0	15	0
Hoisting (say 40 ft.), 2 labourers, 10 minutes, at 2s. 6½d. per hour	0	0	5
Cement mortar, ⅛ ft. cube, at £1 18s. 8d. per yd. .	0	0	2½
Fixing, mason (or bricklayer) and labourer, 10 minutes, at 2s. 11¼d. per hour	0	0	6
Cost of 3 ft. run of coping . . .	£1	7	8½

Dividing the above gives the cost per foot run of, say, 8s. 11½d.

In connection with the above item, the following would probably appear, viz. :—

No. 2 external mitres to ditto.
No. 2 internal ,, ,,
No. 2 fair ends ,, ,,

These items are for labour only, as any extra stone would already be included in the measurements. The mitres work out at the same cost each, and are worth 2 hours of mason's time. The fair ends are worth 1 hour each.

York Cover Stones to Steel Beams, 9 ins. in width.—The edges will need but roughly trimming and there will be no labour to add for fixing, as this will be done by the bricklayer, and as no deduction would be made from the brickwork for the space occupied by cover stones, this will allow for cost of fixing. Assume a length of 10 ft. :—

York stone, 3 ins. thick, 7 ft. 6 ins. super, at 2s. 8d.	£1	0	0
Waste on ditto, 2½ per cent.	0	0	6
5 ft. super, rough trimming at 3d.	0	1	3
Cost per 10 ft. length	£1		

Dividing the above by 10 gives price per foot run of 2s. 2d.

York Stone Templates, 9″ × 9″ × 3″.—These are numbered, and the price can be obtained by taking three-quarters of the price per foot run of cover stone of similar width, viz. 1s. 7½d.

York Stone Templates, 14″ × 14″ × 3″.—The price can be obtained by taking 1⅛ the price per foot run of cover stones, viz. 2s. 5d.

Stone Steps.

Ordinary stone steps are billed per foot run, and the prices can be worked out as detailed for stone dressings, but all spandril steps and winders to all steps are now numbered (in accordance with the "Standard method"), and to price such items it is necessary to take out "rough quantities." With spandril steps it is often assumed (in books written upon quantities) that two steps can be obtained from one block of stone; but in actual practice it frequently is not possible, especially if the steps have squared ends for building into the brick walls in a proper manner.

Detailed Costs.

Portland Stone Spandril Steps, 4 ft. 3 ins. long (9 ins. embedded in wall), out of 14″ × 9″ stone, with 11-in. rubbed tread, 7-in. rubbed riser, with rounded nosing and moulding below same.

To obtain a price, assume a small flight of eight spandril steps. If the student makes a sketch from the above sizes, he will find it easier to check the following "rough quantities." It will be noticed that the squared end has not been dealt with separately, as the "over-all" dimensions will cover any extra cost :—

		£	s.	d.
3 ft. 9 ins. cube Portland stone, at 6s.		1	2	6
Waste on ditto, 5 per cent.		0	1	1½
11 ft. 4 ins. super, half cost of sawing, at 3½d.		0	3	
5 ft. super plain face (top), at 2s. 6d.		0	12	
6 ft. super sunk face (top)				
3 ft. 2 ins. super ditto (front)				
11 ins. super ditto (side)	Total			
1 ft. 9 ins. super ditto (notching for lower joint)	12 ft. 7 ins., at 3s. 4d.	2	1	11½
9 ins. super ditto (chamfering for top joint)				
1 ft. 3 ins. super of moulded work, 3 ins. girth, at 6s. 8d.				
Cost of stone for one step		4	9	11½
Special mortar (see Chapter XI.), 2½ ft. cube, at £1 10s. 8d. per yard		0	2	10
8 steps in Portland stone, as detailed, at £4 9s. 11d.		35	19	4
2 labourers, erecting timbering and scaffold, 2 hours at 2s. 6½d.				
Mason and labourer, erecting 8 steps, 6 hours, at 2s. 11½d.		0	17	7½
"Cleaning-off," labourer, 4 hours, at 1s. 3½d.		0	5	1
		37	9	11¾

Dividing the above by 8 gives the price per step of £4 13s. 9d.

Portland Stone Spandril Winders, average 5 ft. 9 ins. long (9 ins. embedded in wall), out of 20″ × 9″ stone, all as described for spandril steps in last item.

For the above item assume three winders in connection with the eight steps previously given :—

		£	s.	d.
6 ft. 3 ins. cube Portland stone, at 6s.		1	17	6
Waste on ditto, 5 per cent.		0	1	10½
18 ft. 3 ins. super, half cost of sawing, at 3¾d.		0	5	7½
9 ft. 7 ins. super plain face (top), at 2s. 6d.		1	3	11½
12 ft. 11 ins. sunk face (soffit)	Total, 21 ft. 1 in. super, at 3s. 4d.	3	10	3¼
4 ft. 5 ins. super ditto (front)				
2 ft. 4 ins. super ditto (notching of lower edge)				
1 ft. 5 ins. super ditto (chamfer of top edge)				
6 ins. super sunk face, circular (end), at 3s. 9d.		0	1	10½
1 ft. super moulded work (3-in. girth), at 6s. 8d.		0	6	8
8-in. run cove, 3-in. girth circular, at 10d.		0	0	6¾
Cost of stone per winder		£7	8	4
Special mortar, 1½ ft. cube, at £1 10s. 8d. per yard.		0	1	8½
3 winders in Portland stone, as detailed, at £7 8s. 4d.		22	5	0
2 labourers, erecting timbering and scaffolding, 2 hours each, at 2s. 6½d.		0	5	1
Mason and labourer, erecting, 6 hours, at 2s. 11½d.		0	17	7½
" Cleaning-off," labourer, 2 hours, at 1s. 3½d.		0	2	6½
		£31	0	3½

Dividing the above total by 3 gives the price per winder of £10 6s. 9d.

Portland Stone Landing out of stone 4′ 3″ × 4′ 3″ × 9″, with rounded nosing and moulding to one edge to suit spandril stairs, as detailed in last two items :—

	£	s.	d.
13 ft. 7 ins. cube Portland stone, at 6s.	4	1	6
Waste on ditto, 5 per cent.	0	4	1
31 ft. super, half cost of sawing, at 3¾d.	0	9	8½
36 ft. 2 ins. super plain face (top and soffit), at 2s. 6d.	4	10	5
8 ft. 7 ins. super sunk face (remainder of faces), at 3s. 4d.	1	8	7½
1 ft. 1 in. super moulded work, at 6s. 8d.	0	7	2¾
Fixing, 1 mason and 2 labourers, 1 hour, at 4s. 2½d.	0	4	2½
Erecting timbering and scaffold, 2 labourers, ½ hour, 2s. 6½d.	0	1	3¼
Total cost of 1 landing	£11	7	0

Dividing by 18 gives the price per foot super of, say, 12s. 7½d.

In connection with the above staircase, the following additional items might appear :—

Extra for Curtail Step and Bull-nosed Riser.—This can be built up from the items in spandril stairs, adding the extra stone required for the whole length of step due to the increased size.

Mortices for Balusters.—These are numbered, and are worth about ½ hour each of mason's time.

In connection with the staircase there would be an item in the bricklayer's bill as follows :—

Build-in Ends of Stone Spandril Steps.—Although "sand courses" would have been left for these steps, there would be additional labour cutting and building in the ends, and this is worth about ¼ hour for bricklayer and labourer for end of each step.

Artificial Stone.—The cost depends upon the nature of the mouldings, and quotations should be obtained. The prices are about 7s. 6d. per foot cube. If the stone is supplied only, and the builder has to fix, it is worth about 1 hour per foot cube, and will require $\frac{1}{7}$th of 1 ft. cube of mortar per foot cube of stone.

Prices of Stone and all Labours, fixed complete by Specialist Contractors.—

The following classifications are those given in the 1935 Standard Method of Measurement, and for the prices the writer is indebted to the Bath and Portland Stone Firms Ltd., who kindly supplied them.

The prices include fixing, but not mortar, water, scaffolding, or use of hoists.

Prices of Bath and Portland Stone.—

	Bath (Monk's Park). Per Foot.		Box Ground. Per Foot.		Portland. Cube Prices	
	s.	d.	s.	d.	s.	d.
1. Pilasters and quoins	9	8	9	11	16	0
2. Pilasters sunk to entasis	10	2	10	5	16	6
3. Caps and bases to pilasters	14	10	15	10	19	0
4. Jambs (Plain)	9	10	10	1	15	9
5. Lintels (Plain)	9	10	10	1	15	3
6. Springers (Plain)	10	4	10	8	16	0
7. Voussoirs (Plain)	10	4	10	8	16	6
8. Keystones (Plain)	10	4	10	8	16	9
9. Columns	11	1	11	6	15	3
10. Columns sunk to entasis	11	8	12	2	16	0
11. Caps and bases to columns	16	7	17	7	19	0
12. Large cornices and string courses	10	1	10	5	14	9
13. Angle stones to ditto	10	10	11	4	15	3

PAVIOR.

Granolithic Paving.—Granite chippings cost in London about 18s. per ton delivered, and 1 ton is equal to three-quarters of one yard cube.

Detailed Cost.—

Granolithic paving 1½ ins. thick composed of five parts of granite chippings (graded from that retained on a mesh of $\frac{1}{16}$ in. to that to pass through a mesh of ½ in.) to two portions of Portland cement.

	£	s.	d.
5 yds. cube of granite chippings, at 22s. 6d.	£5	12	6
2 yds. cube of Portland cement (see Chapter II.), at £2 1s. 2d.	4	2	4
	£9	14	10
Bulk will diminish by one-third, so add 50 per cent.	4	17	5
Total for 7 yds.	£14	12	3
Take one-seventh	£2	1	9
Labour, mixing, and laying, 5 hours, at 1s. 3½d.	0	6	4½
Price per yard cube	£2	8	1½
A thickness of 1½ ins. is one-twenty-fourth of 36 ins., so dividing by 24 gives the price per yard super, if 1½ ins. thick, viz.	£0	2	0
Add extra labour floating, 1½ hours, at 1s. 3½.	0	1	10½
Cost per yard super	£0	3	10½

Brick Paving.—Paving bricks are usually 2 ins. thick and laid flat, and 1 yard super requires 32 bricks, but allowance must be made for waste which will bring the figure to 34 bricks.

Detailed Cost.—

"**Hard red paving bricks** laid flat, jointed and pointed in cement mortar."—

	£	s.	d.
34 paviors, at £4 per 1000	£0	2	10
Cement mortar (1 to 3), ½ ft. cube, at £1 18s. 8d. per yard	0	0	8½
Labour, bricklayer, and labourer, ¾ hour, at 2s. 11½d.	0	2	1½
Cost per yard super	£0	5	7½

Tile Paving.—

Detailed Cost.—

"**Red paving tiles** 6″ × 6″ laid and jointed in cement mortar.'

	£	s.	d.
1 yd. super tiles, at 8s.	£0	8	0
Add waste, 2½ per cent.	0	0	2½
Cement mortar, ½ ft. cube, at £1 18s. 8d. per yard	0	0	8½
Labour, tiler, and labourer, ½ hour, at 2s. 11½d.	0	1	5½
	£0	10	4½

York Stone Paving.—This can be laid upon concrete or a bed of sand which should be at least 2 ins. thick.

Detailed Cost.—2-in. York stone paving slabs laid on and including a bed of sand 2 ins. thick and jointed in cement mortar (1 to 3).

	£	s.	d.
1 yd. super 2 ins. sawn stone slabs	0	1	6½
Add for waste, 5 per cent.	0	0	1
Sand, $\frac{1}{10}$ of 1 yd. cube, at 6s. 6d.	0	0	6½
Cement mortar, ⅛ ft. cube, at £1 18s. 8d. yd.	0	0	1½
Mason and labourer, ¼ hour, at 2s. 11½d.	0	0	8¾
Cost per yard super	£0	3	0

Crazy Stone Paving.—This is used frequently for garden paths, and usually a bed of ashes is specified, and after the stone is laid ashes are pushed into the joints. The material is sold by the ton (at present about 25s.), and the area covered varies with the thickness of the stone, but 8 yds. super is a fair average per ton.

Detailed Cost.—"2-in. random stone paving laid on and including a bed of ashes and jointed in ditto."

	£	s.	d.
1 yd. super of paving at 25s. per ton = 3s. 1½d. yd.	£0	3	1½
Waste, 2½ per cent.	0	0	1
Ashes, $\frac{1}{10}$ of 1 yd. cube, at 5s. 6d.	0	0	0¾
Laying, 2 labourers, ¼ hour, at 2s. 6½d.	0	0	3¼
Cost per yard super	£0	3	6¼

CHAPTER VII.

DRAINLAYER.

THIS is a simple " Trade," and it is now correct for this bill to include the excavating of trenches, concrete beds, brick manholes and iron drains as well as stoneware, although the jointing of the former is done by the plumber.

Manholes and Inspection Chambers.—The prices of the various items of excavation, concrete, and digging can be obtained from data given in " Excavator and Concrete " ; the brickwork items from " Bricklayer," and the rendering from " Plasterer," but to all the above items an addition of 25 per cent. is recommended as the work is in small quantities.

Joints for Iron Drain Pipes.—If the iron pipes are to L.C.C. requirements, the thickness of the metal for pipes of 4 ins. diameter is $\frac{3}{8}$ in., and the space occupied by the lead will be $\frac{1}{4}$ in. by $2\frac{1}{2}$ ins. deep (in the socket). With pipes of 6-in. diameter, the lead joint is $\frac{3}{8}$ in. in thickness and 3 ins. deep (in the socket). The thickness of the pipe is the same as for 4 ins. One square foot of lead 1 in. thick weighs just over 59 lbs., therefore 1 in. cube of lead weighs $\frac{2}{5}$ of one pound.

Lead Required for 4-in. Diameter Pipes.—The internal diameter plus twice the thickness of the pipe gives the internal diameter of the lead cylinder forming the joint. This internal diameter plus twice the thickness of the lead joint gives the external diameter of the lead joint. Take the average of the two diameters of lead, in this case 5 ins., and multiply by $3\frac{1}{7}$ to obtain the average circumference, and multiply the figure thus obtained by the thickness of the lead joint, i.e. $\frac{1}{4}$ in. and by the depth $2\frac{1}{2}$ ins. The result is the lead required in cubic inches which, multiplied by $\frac{2}{5}$ of one pound, gives the weight.

From the above it will be found that a joint on a 4-in. diameter pipe takes just over 4 lbs. of lead.

Lead Required for 6-in. Diameter Pipes.—Using the methods described for 4-in. pipes, it will be found that the average diameter is $7\frac{1}{8}$ ins., and that one joint requires $10\frac{1}{4}$ lbs. of lead.

Iron Drain Pipes.—Pipes can be obtained in various lengths from 3 ft. up to 9 ft. long, and the latter lengths are used as much as possible to save many joints. It should be noted that a short length of pipe thus necessitates an extra joint beyond the average number usually allowed in estimating for ordinary lengths.

Joints for Stoneware Drain Pipes.—These are often specified to be in "neat" cement, and the basic price of this material will be found in Chapter II. With 4-in. diameter pipes the depth of the socket is $1\frac{1}{2}$ in., the width $\frac{5}{8}$ in. and the thickness of the pipe $\frac{5}{8}$ in. With 6-in. diameter pipes the depth of the socket is $1\frac{3}{4}$ in., the width $11\frac{1}{16}$ ins., and the thickness of the pipe $11\frac{1}{16}$ ins.

Cement Required for 4-in. Pipes.—If the cubic content of the socket joint is calculated (and for this purpose decimals are more convenient), it should be noted that about one-third of the material is lost in "coring" the pipe. Extra material is required for forming the collar which is triangular in section and measures about $1\frac{1}{4}'' \times 1\frac{1}{4}''$, but the cement wasted in wiping this collar will be about equal to the quantity used. It must be borne in mind that this material is mixed in small quantities when and as required, and to ensure a water-tight joint no droppings or "corings" should be re-used.

On this basis 1 yd. cube of wet cement will be sufficient for 786 joints which, with "neat" cement at £2 12s. $7\frac{1}{2}$d. (see Chapter II.), gives 1d. (about) per joint; alternatively on the above basis 1 bushel of cement is sufficient for 39 joints.

Cement Required for 6-in. Pipes.—The collar in this case is about $1\frac{3}{8}$ in. by $1\frac{3}{8}$ in. If a detailed calculation is made in a similar manner to the last item, 1 yd. of wet cement will be sufficient for 529 joints or $1\frac{1}{4}$d. per joint, and 1 bushel of cement for 26 joints.

Waterproofed Joints.—Taking the previous total of £4 9s. 5d. per yard cube for waterproofed mortar (1 to 2), it will be found the price per joint is $1\frac{3}{4}$d. for 4-in. and $2\frac{1}{4}$d. for 6-in. pipes.

Stoneware Drain Pipes.—Salt-glazed stoneware pipes are sold in lengths of 2 ft. (i.e. 2 ft. net when laid and jointed). There is a standard list used by all manufacturers, and the discount therefrom varies in accordance with the quantity

ordered and the quality of the pipes. If pipes are ordered in less than two-ton lots, and are required to be "tested" pipes, instead of a discount an addition of about 15 per cent. will be made. If British Standard tested pipes are required, the addition will be about 17½ per cent. If two-ton lots are purchased and ordinary "tested" pipes used, the discount will be 5 per cent.

The following are the "Standard" list prices, viz. :—

4-in. pipes, 1s. 8d. each; 6-in. pipes, 2s. 6d. each. In the examples given later a discount of 5 per cent. will be assumed.

Stoneware Channel Pipes (for Manholes).—These also are in 2-ft. lengths, and the prices are as follows, viz.: Salt-glazed, 4 ins., 1s. 3d.; 6 ins., 1s. 10½d. each. White-glazed, 4 ins., 4s.; 6 ins., 5s. 4d. each. As these channel pipes usually are not purchased in large quantities it is advisable to ignore the discount. The material for jointing will be about one-fourth that required for a pipe.

Labour Laying and Jointing Drain Pipes.

Iron, 4-in. diameter, plumber and mate, ½ hour.
6-in. diameter, plumber and mate, 1 hour.
Stoneware, 4-in. diameter, bricklayer and labourer, ½ hour.
,, 6-in. diameter, bricklayer and labourer, ½ hour.

In addition to the above data, allowance must be made for extra time for labourers lowering and placing the iron pipes in the trench.

The labour jointing channels is about one-third that of jointing a pipe.

Detailed Costs.—

Excavate in Trench for 4-in. Drain (Average Depth 3 ft.), Return, Fill and Ram, and Cart away Surplus.—The price per foot cube for excavation items can be found in "Excavator." If a typical length of 30 ft. run is assumed, a calculation is easier. The pipe being 4 ins. in diameter, its outside diameter is 5½ ins. (see calculation for joints), and as the concrete bed is usually specified to be 6 ins. in width each side of external diameter of the pipe, then the trench will be just under 18 ins. wide (and it is usual to make this 18 ins. wide). Deeper trenches will require to be wider to allow room for working. The cubic space occupied by concrete 18 ins. wide and 6 ins. deep is 22 ft. 6 ins., but as it is usual

for the concrete to be "benched up" each side of the pipe, the cubical contents of pipe and benching can be taken as half the above amount, viz. 11 ft. 3 ins. cube. This means that 33 ft. 9 ins. cube of earth must be carted away (say, 34 ft.). The total excavation is 135 ft. cube, and subtracting 34 ft. leaves 101 ft. cube to be returned, filled, and rammed. Based upon previous costs our analysis is therefore :—

	£	s.	d.
135 ft. cube, excavate in trenches and throw out, at 2s. 0½d. per yard cube	0	10	2½
101 ft. cube, return, fill, and ram excavation, at 3s. 10½d. per yard cube	0	14	9
34 ft. cube, load and cart away, at 4s. 10d. per yard cube	0	6	0
Add extra labour forming trench to falls, 7½ hours, at 1s. 4½d.	0	10	2
Total for 30 ft. run	£2		1½

Dividing by 30 gives the price per foot run of 1s. 4½d.

Excavate in Trenches (all as before) for 6-in. Drain.—This can be calculated as in last item, but the external diameter of the pipe will be 7⅜ ins. and the minimum width of trench 1 ft. 8 ins.

Excavate in Trenches (all as before) but including all Planking and Strutting.—This can be calculated from the previous items in "Excavator," and for timber to both sides of trench will mean an addition of 1s. 1½d. per foot run, being 2¼ multiplied by 3 ft. and multiplied by 2 for both sides of trench.

Concrete Below Pipes.—This can be calculated from the basic prices per yard cube. If the price per foot run of the concrete below the pipes is found first, then it will be quite sufficient if benching is required to add 50 per cent. for the extra labour and material.

Detailed Cost.—

Portland Cement Concrete Bed.—6 ins. thick below 4-in. pipes and projecting 6 ins. each side in width. For this example the trench (30 ft. long) in the former item will be taken, viz. :—

	£	s.	d.
22 ft. 6 ins. cube Portland cement concrete as described (see former item), at £1 0s. 10½d. per yard cube. Add 50 per cent. to ditto for benching = 33 ft. 9 ins. Say 1¼ yds. cube . . .	£1	6	1

Dividing by 30 gives the price per foot run of 10½d.

Glazed Stoneware Drain Pipes.—From the earlier paragraphs it will be seen that the net prices of " tested " pipes are 1s. 7d. each for 4-in. and 2s. 4½d. each for 6-in. The net length of a pipe as laid is 2 ft., therefore a joint occurs at every alternate foot. The time taken is the same for 6-in. as for 4-in. pipes.

Detailed Cost : 4-in. pipe.—

	£	s.	d.
One pipe, 2 ft. long	0		7
Cement for one joint (see earlier)	0		1
Bricklayer and labourer, laying pipe and making joint, ¼ hour, at 2s. 11½d.	0		8¾
Price per 2-ft. length	0	2	4¾

Dividing by 2 gives the price per foot run of 1s. 2½d.

Detailed Cost : 6-in. pipe.—

	£	s.	d.
One pipe, 2 ft. long	0		4¾
Amount for one joint (see earlier)	0		1¾
Bricklayer and labourer, laying pipe and making joint, ¼ hour, at 2s. 11½d.			8¾
Price per 2-ft. length	0	3	2¾

Dividing by 2 gives the price per foot run of 1s. 7¼d.

Bends, Junctions, and other Fittings.—These are always priced " extra only," and numbered, so it is necessary to deduct the cost of plain pipe from the maker's charges for special fittings, and then add for extra joints as shown in the last two items.

Waterproofed Cement for Jointing.—This is detailed earlier.

Cast-iron Drain Pipes.—If these are of L.C.C. weight and coated inside and outside with Dr. Angus Smith's solution, the present prices are 14s. 9d. for a 9-ft. length of 4-in. pipe, and 22s. 6d. for a 9-ft. length of 6-in. pipe.

Detailed Cost : 4-in. pipe.—

	£	s.	d.
One pipe, 9 ft. long	0	14	9
2 labourers, lowering pipe into trench and placing in position, 10 minutes, at 2s. 6½d. per hour	0		5¼
Metal for joint, 4¼ lbs., at 2d.	0		8½
Yarn (say)	0		1
Plumber and mate, jointing, ¼ hour, at 2s. 11½d.	0		5½
Cost per 9-ft. length	0	17	5¼

Dividing by 9 gives the price per foot run of 1s. 11¼d.

Detailed Cost : 6-in. pipe.—

	£	s	d
One pipe, 9 ft. long	1	2	6
2 labourers (as in last item) . . .	0	0	5½
Metal for joint, 10¼ lbs., at 2d. . . .	0	1	8½
Yarn (say)	0	0	1½
Plumber and mate, jointing, 1 hour, at 2s. 11½d.	0	2	11½
Cost per 9-ft. length	£1	7	8½

Dividing by 9 gives the price per foot run of 3s. 1d.

Bends, Junctions, etc.—These are priced " extra only," and extra joints are required, the price of which must be added.

Testing Drains.—A suitable allowance is for one skilled mechanic and one labourer, 3 minutes per foot run for 4-in. pipes, and 4 minutes per foot run for 6-in. pipes.

Gullies.—The prices of these can be obtained from the merchants' catalogues, but in addition to the extra joint, about 1 ft. cube of extra concrete is required.

CHAPTER VIII.

REINFORCED CONCRETE ENGINEER.

Reinforced Concrete.—As a rule, buildings constructed entirely or partly of reinforced concrete are designed by specialist firms, and erected by specialist contractors or ordinary contractors under expert supervision. It is impossible in a book of this size to treat the subject adequately, or to attempt the preparation of data for pricing the different jobs and the different systems. In an ordinary building it is not unusual to find certain reinforced concrete items such as lintels, sills, and staircases, and although estimating for reinforced concrete floors and beams is a task for a specialist, a typical case is given. In accordance with the "Standard Method of Measurement," and the regulations of the "Institute of Structural Engineers," the carpenters' work in forming the shuttering, the smiths' work in connection with the reinforcement, and the concrete itself, are all included in one bill.

Detailed Prices and Typical Example.—For the purpose of the preparation of analyses, a typical case is taken from the City and Guilds of London Institute Examination in Quantities, held in 1915; a floor was given which will serve our purpose. The floor was shown as 16 ft. wide, 35 ft. in length, and 4 ins. deep, supported upon six beams, each 6 ins. wide and 12 ins. deep, and the following calculations regarding shuttering and reinforcement are based upon a similar floor. Nothing has been added for cost of designing the floor or beams.

No sketch is given for this item as the author wishes the student to make his own sketches, but should an illustration be required, it will be found in "Quantity Surveying for Builders," by Evershed (p. 112), in this series of books.

In making a sketch, the student can assume the following, viz. :—

(1) There are four intermediate beams and two external or end ones.
(2) That the beams and slabs have a 6-in. bearing on the walls, giving a clear span of 15 ft.
(3) That the depth of each beam is 12 ins. below the soffit of floor, and that where the beam adjoins the floor there is a chamfered fillet each side.

Shuttering or Form Work.—It is obvious that this is the most difficult work to price, and occasionally it is the only work in a ferro-concrete structure that falls to the lot of the builder.

The Bill of Quantities for the shuttering for the typical floor as described might contain the following items : " 60 ft. run 1½ in. deal shuttering for six concrete beams, 6 ins. by 12 ins., including all chamfered edges and chamfered fillets ; with 4" × 4" main struts, 9" × 3" sole-plates, 9" × 1½" head-plates, 7" × 2" bearers, 4" × 2" plates, and all folding wedges complete. Girth 2 ft. 7½ ins.

" 30 ft. run ditto, ditto. Girth, 2 ft. 9½ ins.

" 475 ft. super 1½ ins. deal shuttering, all as described, but in upper floors."

It will be noticed that by this method of measurement the area of the boarding where it touches the concrete is the measurement taken, to include all other timbers, including those supporting the shuttering. The two measurements for girth in the beam shuttering include the chamfered fillets. The total superficial area of the whole of the shuttering for beams and floors can be taken as 716 ft. The system of measurement may not appeal to everyone, but as it is the " Standard Method," it is necessary for Quantity Surveyors to adhere to it, for the sake of uniformity. Shuttering is without doubt the most difficult of all items for the Estimating Surveyor to analyse, but the following detailed cost is submitted in the hope that it may serve as a rough guide.

Cost of Shuttering.—For the purpose of preparing a detailed cost, it is assumed that there are three floors in the same building, similar in all respects, and that the shuttering can be re-used, therefore the cost of new timber for one floor must be calculated first. The height is taken for each storey

as 12 ft., and it is assumed that each beam will require two supports. The timber is taken at £20 per standard, which will include cost of delivery, conversion, and ordinary preparation, and this works out at 2s. 8d. per foot cube. (See "Carpenter" in Chapter II.)

Detailed Cost.—

FIRST FLOOR.

	£	s.	d.
90 ft. run of 3″ × 9″, at 6d.	£2	5	0
126 ft. run of 4″ × 4″, at 3½d.	1	16	9
12 pairs of large folding wedges, at 9d. per pair	0	9	0
90 ft. run of 1½″ × 9″, at 3d.	1	2	6
64 ft. run of 2″ × 7″, at 3d.	0	16	0
150 ft. run of 2″ × 4″, at 1½d.	1	1	10
20 pairs of small folding wedges, at 4d. per pair	0	6	8
7½ squares super of 1½-in. boarding, at 30s. per square	11	5	0
Total cost of timber	£19	2	9
Waste on timber, 5 per cent.	0	19	2
Cartage to job, 1¾ tons, at 20s.	1	15	0
Labour, loading and unloading, 3 hours, at 1s. 3½d.	0	3	9¾
Erecting shuttering, 2 carpenters and 3 labourers, 24 hours, at 7s. 1½d.	8	11	6
Striking shuttering, 2 labourers, 12 hours, at 2s. 6½d.	1	10	6
First cost of shuttering	£32		8¾

SECOND FLOOR.

	£	s.	d.
Waste and replacement of timber, 10 per cent. on £19 2s. 9d.	£1	18	3
Erecting shuttering, 2 carpenters and 3 labourers, 16 hours, at 7s. 1½d.	5	14	
Striking shuttering, 2 labourers, 12 hours, at 2s. 6½d.	1	10	
Second cost of shuttering	£9	3	

THIRD FLOOR.

	£	s.	d.
Waste and replacement, as in last cost	£1	18	3
Erecting, as for second floor	5	14	4
Striking, as before	1	10	6
Loading from job, 2 labourers, 3 hours, at 2s. 6½d.	0	7	7½
Carting away from job, 1¾ hours, at 20s.	1	15	0
Third cost of shuttering	£11	5	8½

SUMMARY.

First cost of shuttering	£32	2	9
Second ,, ,,	9	3	1
Third ,, ,,	11	5	8
Total cost for three floors	£52	11	6
Deduct value of timber returned to store, 25 per cent. of £19 2s. 9d.	4	15	8
Nett cost of three floors	£47	15	10
Dividing the above total by 3 gives the price per floor of	£15	18	7
Add for nails and screws, 2s. 6d. per square of 100 ft. super	0	18	9
Nett cost of one floor	£16	17	4

Dividing the above total by 716 gives the approximate price per foot super of 5¾d. for the whole of the shuttering.

Using this price per foot super, it is a simple matter to ascertain that the price per foot run for the beam 2 ft. 9½ ins. girth is 1s. 4d., and for the beam 2 ft. 7½ ins. girth, the price is 1s. 2½d. per foot run.

In some cases it is advisable to increase the prices for shuttering to beams, as there is greater waste; a small allowance of 5 per cent. is suggested.

Nails and Screws for Shuttering.—In the above detailed cost it will be noticed that 2s. 6d. per square has been added for nails and screws, which is a fair allowance.

Cost of Reinforcement.—In the six beams carrying the floor there are six bars of ¾-in. round steel, each 16 ft. 5 ins. long, and there are six similar bars cranked, which are each 16 ft. 10 ins. long. Connecting the rods there are 126 stirrups of 1¼-in. metal, with the ends bent and cranked; all these items are billed by weight. The ordinary steel rods will be found to weigh 31 lbs. each; the cranked rods, 34 lbs. each, and the total weight of all stirrups will work out at 84 lbs.

In the floor itself there are fifty-four rods, each ¼ in. in diameter, and these require tieing wires; the total weight of small rods and wires amounts to 186 lbs. Typical items in the Bill of Quantities will read as follows:—

Mild Steel Bars over ⅜-in. in diameter, and including all tieing wires, bends and fixing complete.—

	£	s.	d.
186 lbs. mild steel in bars, at 11s. per cwt. . . .	0	18	3
Smith and labourer, bending, etc., 1 hour, at 2s. 11½d. .	0	2	11½
2 labourers, placing in position, ½ hour, at 2s. 6½d. .	0	1	3½
Total cost	£1	2	5½

Dividing by the total weight of 186 lbs. gives the price per lb. of 1·45 pence, or 13s. 5d. per cwt.

Mild Steel Bars as above, but Cranked.—

	£	s.	d.
Cost of ordinary bars, as last item . . .	£1	2	5½
18 lbs. additional mild steel, at 11s. per cwt. . .	0	1	9½
Extra time, smith and labourer, forming cranks, 1 hour, at 2s. 11½d.	0	2	11½
Total cost .	£1	7	

Dividing the above by 205 gives the price per lb., approximately, of 1·6 pence, or 14s. 11d. per cwt.

Stirrup Straps, including all bends, cranks, tieing wires, and fixing complete.—

	£	s.	d.
84 lbs. mild steel in bars, at 12s. per cwt. . .	£0	9	0
Smith and labourer, bending same, 6½ hours, at 2s. 11½d.	0	19	1
2 labourers, placing in position, 5 hours, at 2s. 6½d.	0	12	8½
	£2	0	9½
Add 5 per cent. for tieing wires	0	2	0½
Total cost	£2	2	10

Dividing the above by 84 gives the price per lb., approximately, of 6·12 pence, or £2 17s. 1d. per cwt.

Mild Steel in Bars, ⅜-in. in Diameter, in floor decking, including all tieing wires, bends, and fixing.—

	£	s.	d.
54 rods, each 15 ft. 11 ins. in length, equal to 181 lbs., at 11s. 6d. per cwt.	£0	18	7
Smith and labourer, bending ditto to shape, 4½ hours, at 2s. 11½d.	0	13	2½
Labourer, placing in position, 3 hours, at 1s. 3½d. .	0	3	9½
	£1	15	7½
Add 5 per cent. for tieing wires . . .	0	1	9½
Total cost	£1	17	5

Dividing the above by 181 gives the cost per lb. at approximately 3·75 pence, or £1 15s. per cwt.

In the Examination Paper fish-tailed ends are shown, but as these are now obsolete they are omitted here.

Cost of Reinforced Concrete.—The cost of ordinary concrete is analysed in Chapter IV., but frequently the

materials for reinforced concrete are proportioned in a different manner.

For concrete in contact with the ground and for foundations the usual proportions are 6 to 1, as described in "Excavator and Concrete." For concrete in retaining walls and upper floors a common proportion is 4 : 2 : 1, but naturally the mixtures vary in accordance with the working stresses adopted. The "Code of Practice" dated 1933 permits 4 : 2 : 1 concrete to take a load of 600 lbs. per square inch, and a very rich concrete, i.e. 1 : 1 : 2, can be stressed up to 1000 lbs. per square inch. The Code is published by His Majesty's Stationery Office, price 1s. 3d.

The materials must be chosen with care; the cement must conform to the British Standard Specification of 1931; the sand must pass a mesh of $\frac{3}{16}$ in. measured in the clear, but it must not be used if it contains more than 10 per cent. of fine grains that will pass a 76 mesh sieve as used for cement tests. Alternatively the proportion of cement may be increased to counteract this.

The aggregate for the mass concrete must consist of good hard stones as will pass a mesh of 2 ins., and for upper floors is to be crushed so as to pass a mesh of $\frac{3}{4}$ in. and the size of the stones must vary uniformly from $\frac{3}{16}$ in. to this. For hollow tile floor filling, the maximum size of stones should not exceed $\frac{1}{2}$ in. in diameter.

The following proportions are used upon an actual job in progress at the time of writing :—

Concrete 6 : 3 : 1 (for mass concrete and in surface concrete 3 ins. or 4 ins. thick over site).—

Cement, 3½ cwts., or feet cube	4·35
Sand, feet cube . . .	12·50
Aggregate stones, feet cube	25·25
Feet cube	42·10

(Making approximately 1 cub. yd. of concrete.)

Concrete 4 : 2 : 1 (for walls and floors).—

Cement, 5 cwts., or feet cube	6·2
Sand, feet cube . . .	12·0
Aggregate stones, feet cube .	24·25
Feet cube	42·45

(Making approximately 1 cub. yd. of concrete.)

If these figures are analysed it will be found that the concrete gauged in the proportions of 6 : 3 : 1 reduces in bulk by 36⅔ per cent., and that gauged 4 : 2 : 1 reduces in bulk by 35½ per cent.

These figures should be compared with those given in Chapter IV. for ordinary concrete.

Using the above information, the following examples can now be calculated. Cement will be taken as £2 1s. 3d. per ton, or £2 5s. per yard cube; sand at 8s. 3d., and broken ballast at 8s. 6d. per yard cube respectively.

Detailed Cost.—

Mass Concrete gauged 6 : 3 : 1 *and well tamped around Steel.—*

4·35 ft. cube Portland cement, at 1s. 8d.	£0	7	3
12·5 ft. cube washed sand, at 3½d.	0	3	10½
25·25 ft. cube clean aggregate, at 4d.	0	8	5
Labour, mixing, laying and tamping, 6 hours, at 1s. 3½d.	0	7	7½
Price per yard cube	£1	7	2½

Detailed Cost.—

Fine Concrete in Reinforced Work gauged 4 : 2 : 1 *and well tamped around Steel.—*

6·2 ft. cube Portland cement, at 1s. 8d.	£0	10	4
12·0 ft. cube sand, at 3½d.	0	3	9
24·25 ft. cube clean aggregate, at 4d.	0	8	1
Labour, mixing, laying and tamping, 8 hours, at 1s. 3½d.	0	10	2
Price per yard cube	£1	12	4

Concrete in Floors, etc. (*per yard super*).—Many items have to be priced per yard super for a stated thickness, as shown in the typical floor, and these thicknesses can be found by simple division, i.e. the cost of a yard super 6 ins. thick can be found by dividing the cost per yard cube by 6 (because 6 ins. is one-sixth of 36 ins., or 1 yd.); other thicknesses can be found in a similar manner, but an extra allowance must be made for spreading and for tamping. The following are suggested, viz.: for concrete over site, ½ hour, and for upper floors, ¾ hour for one labourer.

Using the above information, and the previous detailed costs, it will be found that the floors 6 ins. thick will amount to 5s. 2d. and 6s. 4d. per yard super respectively.

Concrete in Beams (*per foot cube*).—This can be found by proportionate methods, and no extra allowance is necessary unless the work is in isolated positions similar to lintels.

Breeze Concrete Lintels.—These are billed per foot cube or per foot run, stating thickness and depth, and the price has to include the necessary moulds or boxes in which the lintels are cast. For a typical example, assume two lintels each 6 ft. in length, 9 ins. in width, and 9 ins. in depth; and for the purpose of calculating the use and waste of the boxes, it is assumed that each will be used six times.

Use and Waste of Casting Boxes.—

	£	s.	d.
30 ft. super 1-in. boarding, at 18s. per square	0	5	5
60 ft. run 2″ × 1″ battens, at 3s. 2d. per 100 ft.	0	1	11
Carpenter, 1 hour, at 1s. 8d.	0	1	8
Nails (say)	0	0	2
Cost of making 2 boxes	£0	9	2

Use and waste, one-sixth of above (two boxes), 1s. 6d.
Dividing by 12 gives 1½d. per foot run.

Breeze Concrete Lintels (1 to 5), including hoisting and fixing.—

	£	s.	d.
4½ ft. cube coke breeze, at 8s. 3d. per yard	£0	1	4½
1 ft. cube Portland cement, at 1s. 8d.	0	1	8
Labourer, casting, 3 hours, at 1s. 3½d.	0	3	9¾
Hoisting and fixing, bricklayer and labourer, ½ hour, at 2s. 11½d.	0	1	5½
Cost of lintels	£0	8	3¾

Dividing by 12 gives the cost per foot run at, say, 8¼d., and to this the cost of casting boxes must be added.

The reinforcement can be calculated as detailed for floors.

Preparing Soffits of Concrete Floors for Rendering.—Usually it is necessary to hack the soffits of concrete floors ready for the plasterer to finish the surface in Portland cement rendering. The cost of this varies in accordance with the class of work, but a fair allowance would be one labourer, ½ hour per yard super.

Combined Reinforcement and Centering.—The use of expanded metal for concrete floors is not a new method of reinforcement, but during the past few years a development has taken place whereby the reinforcement becomes the centering as well, or at least a considerable portion of the centering. The

expanded metal used is formed with ribs at intervals, and this material is supplied cut to the lengths specified, bundled, and marked, which obviously saves much time. The material costs more than ordinary reinforcement, but a saving will be effected by the omission of a considerable amount of shuttering, and no hacking will be necessary to the soffits as the expanded metal surface forms an excellent key for the plasterer.

Detailed Cost.—For the purpose of preparing a detailed cost, a floor similar to the previous floor is taken, but the whole floor area is measured.

Expanded Metal as Reinforcement (self-centering).—

	£	s.	d.
62 yds. super expanded metal, at 2s. 6d. per yard .	7	15	0
Add for tieing wires, 2½ per cent. . . .	0	3	10½
2 labourers, placing in position, 2 hours, at 2s. 6½d.	0	5	1
	£8	3	11½

Dividing the above total by 62 gives the price per yard super of 2s. 7¾d.

In the above example it has been assumed that the concrete beams are omitted and steel beams substituted, and as the spans are too great for self-centering alone, it will be necessary to add for temporary supports, the cost of which are analysed in a similar manner to shuttering, viz. :—

Supports for Self-centering.—For this purpose a similar floor is taken as in the previous items, and it is assumed that each bay will require two 15 ft. lengths of 3″ × 2″, two 15 ft. lengths of 7″ × 2″ supported on two cross-pieces of 7″ × 2″.

Detailed Cost : Temporary Supports.—

FIRST FLOOR.

	£	s.	d.
214 ft. run of 7″ × 2″, at 3 1/12d. . . .	2	15	0
150 ft. run of 3″ × 2″, at 1⅛d. . . .	0	16	8
	£3	11	8
Add 6½ per cent. for waste	0	4	8
	£3	16	4
1 carpenter and 2 labourers, erecting and striking, 8 hours, at 4s. 2½d.	1	13	8
Cartage to job (say), ¾ ton at 20s. . . .	0	15	0
First cost	£6	5	

SECOND FLOOR.

Waste and replacement of timber, 10 per cent. of cost of timber	£0	7	7¾
Cost of erection, etc., as previous item	1	13	8
Second cost	£2		3¾

THIRD FLOOR.

Waste and replacement of timber, 10 per cent. of cost of timber	£0	7	7¾
Erecting and striking, as before	1	13	8
Loading away from job, 2 labourers, 1 hour, at 2s. 6½d.	0	2	6½
Cartage from job, ¾ ton, at 20s.	0	15	0
Third cost	£2	18	10¼

SUMMARY.

First cost	£6	5	0
Second cost	2	1	3¾
Third cost	2	18	10¼
Total cost	£11	5	2
Deduct value of timber returned to store—25 per cent. of original cost	0	17	11
Total nett cost	£10	7	3

Dividing the above total by 3 gives the cost per floor of £3 9s. 1d., and dividing this total by 62 gives the cost per yard super of 1s. 1¼d. which must be added to the cost of the self-centering.

The cost of temporary supports depends upon the spans, and the manufacturers' handbooks should be consulted before working out the costs, so as to find exactly what temporary timber is necessary.

Metal Supports.—For the upright members of shuttering metal adjustable supports are now often used on modern buildings, and their use will effect a saving on the timber by approximately 30 per cent.

Patent Fire-resisting Floors and Roofs, i.e. Hollow Tile Floors.—These are designed by specialists, and the costs vary in accordance with the load and the type of block used. Hollow terra-cotta blocks 12″ × 12″ × 6″ cost about £21 per 1000 in London, and special light blocks as much as £36 per 1000.

The labour placing the blocks in position varies in accordance with the sizes of the blocks used, but for 12″ × 12″ × 6″ blocks, two labourers will cover 100 yds. super in 20 hours. The concrete used is similar to that described for reinforced upper floors, and the quantity required varies, but for 12″ × 12″ × 6″ tiles laid with 3-in. beams and with a slab 2 ins. thick, 1 yd. super will require 2½ ft. cube of concrete. The reinforcement differs with every type of floor, but 100 yds. super of floor will require about 15 cwts. of metal rods ¾-in. and ¼-in. diameter. It is usual to specify the type of block used, and the price must include tiles, concrete, and the reinforcement, but not formwork. (See 1935 Standard Method of Measurement.)

Detailed Cost.—

"**Hollow tile floor with** 12″ × 12″ × 6″ *tiles. Concrete* 4 : 2 : 1 (*as before described*) *reinforced with* ¾*-in. and* ¼*-in. mild steel rods*, in upper floor 15 ft. above ground level."

As a typical example assume a floor 100 yds. super.

	£	s.	d.
900 hollow tile blocks delivered, at £22 per 1000	19	16	0
Waste, 2½ per cent.	0	9	11
Unloading, 2 labourers, 1 hour, at 2s. 6½d.	0	2	6½
9¼ yds. cube concrete, 4 : 2 : 1 (see previous cost), at £1 12s. 4d.	14	19	1
15 cwts. mild steel in rods, ¾″ and ¼″ in diameter, at 11s. 6d. per cwt.	8	12	6
Laying floor, 2 labourers, 20 hours, at 2s. 6½d.	2	10	10
Extra labour on concrete, it being distributed in floors, 2 labourers, 50 hours, at 2s. 6½d.	6	7	1
Cost per 100 yds. super	£52	17	11½

Dividing by 100 gives the price per yard super of 10s. 7d.

The last labour item in the above cost will vary considerably, because some engineers insist that the joints between the rows of tiles are cemented whereas others do not. The previous example assumes that the blocks are not jointed. With some systems the shuttering can be reduced considerably, as described earlier for "self-centering."

CHAPTER IX.

SLATER, TILER, AND ROOFER.

THE methods of measurement are similar for both slater and tiler, but unfortunately there are two methods still in force. The "Standard Method of Measurement" gives full instructions for the measurement of the actual surfaces covered with roofing material and states that all cuttings and extras, such as "Double course at eaves"; "Extra to verge"; "Cutting and waste to square abutments"; "Tile and a half"; "Cutting and waste to top edge," and all similar items, are to be priced per foot run. In London and the South of England, a Code still exists entitled "Customary Rules of Measurement," which was compiled by the London Association of Master Slaters and Tilers (Finsbury Court, Finsbury Pavement, London, E.C.2, price 2s. 6d.), and this Code states that the different allowances and cuttings are to be measured as the running lengths multiplied by different allowances in inches, and the dimensions added to the nett area of the slating or tiling. In other parts of England this does not apply, but in the South it is sometimes difficult for a builder (who wishes to sub-let the roof coverings to a specialist firm) to adjust the measurements. The actual pricing of the Bill is simple, and needs no further explanation.

SLATER.

Gauge and Lap.—The student is reminded at this stage of the great difference between these terms, especially as slating is usually described by its lap, and to remember that the gauge is different for slates which are nailed in the middle and for slates nailed at the head.

To find the gauge for slates nailed at the head, deduct the lap plus 1 in. (for portion above nail) from the length of slate and

divide by 2. To find gauge of slates nailed in the middle, simply deduct lap from length of slate and divide by 2. It will be seen that a 3-in. lap with 20″ × 10″ slating gives an 8-in. gauge for slates nailed at head, and 8½-in. gauge for slates nailed in the middle; this affects the number of slates required per square.

Number of Slates per Square.—A few years ago slates always were sold by the "mille" of 1200, but now they are sold per 1000 (actual), and are billed by the square of 100 ft. super. In some parts of England the "mille" is still used, and the "mille" is customary at the quarry. To find the number of slates per square, find the area of the gauge in inches (i.e. area of the exposed portion of the slate), and divide it into the area of a square in inches. The following table gives the number of slates required per square when laid to a 3-in. lap:—

Dimensions of Slate.	Number per Square.	
	Nailed at Head.	Nailed in Middle.
Ins.		
18 × 10	206	192
20 × 10	180	170
22 × 12	136	127
24 × 12	120	115

"Double course at eaves," "Verge," and all cuttings are now described to be priced per foot run, and this must be remembered when ordering slates for a job. It is not sufficient to take the number of squares and obtain the number of slates therefrom, as the cuttings cause waste. As slates are somewhat fragile and liable to break, it is usual to allow 2½ per cent. for waste. If slates are purchased at the quarry they are often sold by weight, so the following may prove useful (the weights are per "mille" of 1200, which is still the quarry unit), viz.:—

Size.	Weight.
18 × 10 ins.	32 to 42 cwts.
20 × 10 ,,	33 ,, 47 ,,
22 × 12 ,,	45 ,, 65 ,,
24 × 12 ,,	47 ,, 70 ,,

The weight varies according to thickness and quality.

Nails.—Various kinds of slate nails are used, but composition slate nails are in general demand. 24″ × 12″ slates require

2-in. nails, and 20″ × 10″ slates require 1½-in. nails. The number of nails per square can be found from the number of slates per square, and as nails are sold by weight the following approximate number of nails per pound is given :—

	Size.	No.	Size.	No.
Composition nails .	1½ in.	140	2 ins.	90
Zinc nails . .	1½ ,,	200	2 ,,	80

Copper nails weigh about the same as composition nails.

In compiling prices in this trade, it will be found that there are apparent anomalies. The largest slates are not necessarily the most expensive. Slating contractors purchasing slates at the quarry can always quote more favourably than a builder. Economy is effected if one labourer attends upon two slaters, but this is not always possible. The following detailed costs are based upon the builder receiving 1000 slates, but slating contractors purchasing large quantities, receiving the "mille" of 1200 at the quarry and frequently an allowance for waste in addition, can quote much cheaper. The old terms of classification, viz. : "Duchess," "Countess," etc., are out of date; slates are now described by their sizes.

Detailed Costs.—

Assume that 24″ × 12″ slates cost £28 16s. per 1000 delivered in London, and that 20″ × 10″ slates cost £17 14s., and that in each case two labourers take 1¾ hours each to unload on the job, the cost per 1000 will be £29 0s. 5d. and £17 18s. 5d. per 1000 respectively.

Best Bangor 24″ × 12″ Slates *laid to 3-in. Lap and Centre Nailed with Two Composition Slate Nails per Square.*—

	£	s.	d.
115 slates, at £29 0s. 5d. per 1000 . .	3	6	9
240 compo. 2-in. slate nails, 2¾ lbs., at 3d. .	0	0	8
	£3	7	5
Waste, allow 2½ per cent.	0	1	8¼
Slater and labourer, 2 hours, at 2s. 11¼d. .	0	5	10½
Price per square	£3	14	11¾

Best Bangor 20″ × 10″ Slates *laid to 3-in. Lap and Nailed at Head per Square.*—

	£	s.	d.
180 slates, at £17 18s. 5d. per 1000 . . .			
360 nails, 1½-in. or 2⅜ lbs., at 3d. . . .	0	0	7½
	£3	5	1½
Waste, allow 2½ per cent.	0	1	7½
	£3	6	9
Slater and labourer, 1½ hours, at 2s. 11½d. .	0	4	4½
Price per square	£3	11	1½

Cuttings and Extras.—The slating contractor's charges are based upon the length of the particular item multiplied by a dimension in inches, therefore, the value per foot run can be calculated. For example, "top edge" is valued as length multiplied by 6 ins.; therefore, if slating is worth 75s. per square, the value of top edge is 4½d. per foot run. This can be found easily by taking (say) 100 ft. run of top edge; which multiplied by 6 ins. is equal to 50 ft. super or half a square, which amounts to 37s. 6d. Dividing this figure by 100 gives the price of 4½d. per foot run.

The following are the "Customary" allowances for various labours; the figures represent the multiplier per foot run, viz.:—

Top edge, 6 ins.
Ditto, raking, 9 ins.
Square abutments, 6 ins.
Verge, 6 ins.
Raking abutments, 9 ins.
Ditto, "slate and a half," 15 ins.
Eaves, 12 ins.
,, irregular, 12 ins.
Raking cuttings, 9 ins.
Hips and valleys, 9 ins. each side.

Westmorland Slating.—This is expensive but very durable, and frequently is specified for high-class jobs; copper nails should be used. The slates arrive on the job in various sizes and have to be sorted and graded. The courses also are graded so that the largest slates are fixed at the bottom of the slope and the smallest slates are fixed at the top, so that the courses gradually diminish in size.

Buttermere Light Green slates cost £14 10s. per ton, and Buttermere Olive Green (coarse grained) cost £12 per ton, delivered in London. One ton of the former will cover 270 sq. ft., and 1 ton of the latter 234 sq. ft.

Detailed Cost.—

Buttermere Light Green Random Slates *each Nailed with two Copper Nails laid to Graded Courses.*

	£	s.	d.
7 cwts. 46 lbs. Westmorland slates, at £14 10s.	£5	7	6
4 lbs. copper nails, at 6d.	0	2	0
Waste on slates and nails, 2½ per cent.	0	2	9
Sorting, labourer, 2 hours, at 1s. 3½d.	0	2	
Slater and labourer, 3 hours, at 2s. 11½d.	0	8	
Cost per square	£6	3	7½

Cuttings and Labours.—The value of these can be found as described for ordinary slating, plus an extra 6 ins. for eaves and an extra 3 ins. for all other cuttings and labours.

TILER.

Tiles.—Tiles are priced per square, and are purchased per 1000. Ordinary tiles are usually $10\frac{1}{2}'' \times 6\frac{1}{2}''$, and a gauge of 4 ins. is the most usual, although 3½ ins. is occasionally specified. Tiles weigh (approximately) 1 ton per 1000, therefore the cost of carriage can be calculated easily. It is usual in a Bill of Quantities to include the battens with the tiling, and many specialist firms quote accordingly.

The following are the numbers of tiles required per square of 100 ft. super. If to 4-in. gauge, 555; to 3½-in. gauge, 634; and to 3-in. gauge, 740.

Fixing.—Sometimes oak pegs are used, but nails are most usual. About 1200 wood pegs make a peck, by which unit they are sold, and 100 iron nails weigh 4 lbs.

In London, plain hand-made Broseley tiles cost £5 per 1000; and machine-made tiles £4 per 1000 delivered; and allowing for two labourers unloading, at 1½ hours each, gives a total cost of £5 4s. 5d. and £4 4s. 5d. respectively.

Detailed Cost per Square.—

Plain Broseley Tiling *laid to 3½-in. Gauge, with two Galvanised Iron Nails to each Tile.*

	£	s.	d.
634 plain Broseley tiles, at £5 4s. 5d. per 1000	£3	6	1½
1268 galvanised iron nails, i.e. 31½ lbs., at 4d. per lb.	0	10	6
	£3	16	7½
Allowance for waste, 5 per cent.	0	3	10
Tiler and labourer, 3 hours, at 2s. 11½d.	0	8	9¾
Cost per square	£4	9	3¼

Plain Broseley Tiling *laid to 4-in. Gauge, fixed every Fourth Course with Galvanised Iron Nails to each Tile.*

555 plain Broseley tiles, at £5 4s. 5d. per 1000 .	£2	17	11½
296 galvanised iron nails, i.e. 7½ lbs., at 4d. per lb.	0	2	6
	£3	0	5½
Allowance for waste, 5 per cent.	0	3	0
Tiler and labourer, 2¾ hours, at 2s. 11½d. . .	0	8	0¾
Cost per square	£3	11	6

Pan-tiles—These are used for many purposes, and are also supplied glazed in different colours.

Detailed Cost per Square.—

Pan-tiles laid Dry *to 10-in. Gauge.—*

180 pan-tiles, at £13 per 1000	£2	6	9½
Fixing, tiler and labourer, 2½ hours, at 2s. 11½d. .	0	6	7
Cost per square	£2	13	4½

Cuttings and Extras.—These are calculated in a similar manner to cuttings, etc., for slatings, and the allowance by which the foot run is multiplied are as follows, viz. :—

Top edge, 6 ins.
Ditto, raking, 9 ins.
Square abutments, 6 ins.
Verge, 6 ins.
Raking ditto, 9 ins.
Ditto, " tile and a half," 9 ins.
Eaves, 8 ins.
Ditto, irregular, 14 ins.
Raking cuttings, 9 ins.
Hips and valleys, 9 ins. each side.

If valley tiles, hip tiles, and ridge tiles are used, these will be priced in addition to the above allowances.

Tile Hips, per foot run. Allow for tiler and labourer, 6 ft. per hour.

Valleys, per foot run. Allow for fixing, 5 ft. per hour.

Double Course at Eaves.—Allow for labour (extra only), 25 ft. per hour.

Cement Fillets.—See " Bricklayer."

Tile Hanging.—This can be calculated as for roof tiling, bearing in mind the fact that every tile must be nailed (as shown

in the first detailed cost). Add to the time for tiler and labourer 25 per cent.

Interlocking Tiles.—English interlocking tiles (particularly those from Bridgwater) are much superior to those from abroad and the latter are gradually being displaced. The tiles have a single lap, and it is necessary that the roof be felted so the cost of this must be remembered when making comparisons. Bridgwater double-roman interlocking tiles cost about £23 per 1000 delivered in London. The size is $16\frac{1}{2}'' \times 14''$ and the gauge is $13\frac{1}{2}$ ins.; one square requires 85 tiles.

Detailed Cost.—

Bridgwater Interlocking Tiles *laid to 3-in. Lap (i.e. 13½-in. Gauge).—*

	£	s.	d.
85 double-roman tiles, at £23 per 1000 .	1	19	1
Waste, 5 per cent.	0	2	0
Tiler and labourer, 2½ hours, at 2s. 11¼d.	0	7	4
	£2	8	5

Cuttings and Extras.—These are subject to different allowances which the tiling contractors charge for at agreed money rates, and amount to about 15 ins. to 18 ins. multiplied by the length.

Asbestos-cement Roofing.

This material can be obtained in many forms, and for roofing purposes the most popular forms are the well-known diagonal "tiling" and imitation "slating." Both the above can be obtained in "Poilite," and the writer is indebted to the manufacturers for assistance with the following particulars. For industrial roofs, corrugated asbestos sheets are sometimes used, and the cost of fixing is about equal to corrugated iron. This is described in "Smith and Founder."

"Slating."—The "slates" are supplied in three sizes—$24'' \times 12''$; $15\frac{3}{4}'' \times 15\frac{3}{4}''$; and $15\frac{3}{4}'' \times 7\frac{7}{8}''$. The lap usually specified for the first named is 3 ins., and for the other two sizes, $2\frac{3}{4}$ ins. Each slate requires two nails and one rivet.

Detailed Cost.—

Asbestos-cement "Slating," 24″ × 12″, *laid to* 3-*in. Lap.—*

	£	s.	d.
120 Poilite slates (allowing for waste in cutting, etc.), at £14 per 1000	£1	13	
230 No. 12 B.W.G. 1½-in. nails (allowing for waste) = 1¼ lbs. at 3d.	0	0	3¾
120 copper disc rivets, at 12s. per 1000 . . .	0	1	6
Labour, fixing, 1 skilled man and labourer, 2 hours, at 2s. 11½d.	0	5	10½
Price per square	£2		3½

Detailed Cost.—

Red Asbestos-cement Diagonal "Tiling" *laid to* 3-*in. Lap.—*

	£	s.	d.
93 Poilite tiles, 15¾″ × 15¾″, at £12 12s. per 1000 .	£1	3	6
186 No. 12 B.W.G. 1½-in. nails (allowing for waste) = 1¾ lbs. at 3d.	0	0	5¼
93 copper disc rivets, at 12s. per 1000 . . .	0	1	1½
Labour, fixing, 1 skilled man and labourer, 1½ hours, at 2s. 11½d.	0	4	4¾
Price per square	£1	9	5½

CHAPTER X.

CARPENTER.

Method of Arriving at Prices.—It is usual to separate this trade from the joiner, and although the latter trade is by far the most difficult one to price, the carpentry work is by no means easy. In Bills of Quantities, the greater portion of the carpenter's work is priced per foot cube or per foot run (including all labour and material), and it is a fairly simple arithmetical operation to find the cost of material by such unit, but it is far more difficult to ascertain the cost of labour. A datum can, of course, be prepared from averages taken over a number of similar jobs, but with this information the cost can vary considerably, as certain timbers require more framing than others.

The latest edition of the Standard Method of Measurement requires timbers of different scantlings to be given separately, so this trade is not quite so difficult to price as formerly, when in some parts of the country timbers of different sizes were lumped together.

Bearing in mind the above circumstances, the student may possibly appreciate the following method adopted by the writer, viz.: Carefully take off the quantities of a typical floor, or a typical portion of a roof, and then price the labour and material for the whole of the particular section. Next find the cubical content of the timber used for each scantling and divide this into the total cost of the labour for the typical section of the floor or roof; this will give the labour price per foot cube. The cost of timber can then be added.

The method of obtaining prices per foot cube and per foot run from the cost per standard is explained in Chapter II., which deals with preparatory pricing data. The student is again reminded that what at first sight might appear to be "inches" super and "inches" cube are really twelfth parts of a foot super or a foot cube.

Temporary Work.

The carpenter is frequently called upon to prepare work which is not actually part of the building, but is necessary for other trades, such as planking and strutting, shuttering for concrete work, moulds for casting lintels and similar items. These have been dealt with in the chapters describing the trades concerned, but there are other items which have not yet been mentioned, i.e. centres for arches, etc., and shoring.

Centering.—The "Standard Method of Measurement" gives several descriptions, but all are based upon the superficial area of the surface supported by such centre. As a typical example, a centre for a brick arch will be taken to illustrate the method; centering for other work can be calculated in a similar manner.

Use and Waste of Centering for semi-circular arch of 6 ft. diameter, 3 ft. in height, and width of 18-in. soffit. Timber at 3s. per foot cube.

12 ft. run of 6″ × 1½″, at 2d. per ft. run			£0	2	0
30	6″ × 1″	1½d.	0	3	9
50	9″ × 1″	2¼d.	0	9	4½
50	4″ × 2″	2d.	0	8	4
10	4½″ × 3″	3½d.	0	2	8½
60	2″ × 1″	½d.	0	2	6
Folding wedges			0	2	0
			£1	10	8
Add 5 per cent. for waste on timber			0	1	6½
Preparing centre, 2 carpenters, 6 hours, at 3s 4d.			1	0	0
Fixing ditto and striking, 2 labourers, ½ hour, at 2s. 6½d.			0	1	3½
Cost			£2	13	5½
Deduct value of timber returned to store (say 25 per cent.)			0	7	8
Total cost of centre			£2	5	9½

The struts supporting the above centre have been taken as 10 ft. in height.

In accordance with the "Standard Method of Measurement" the centres for semi-circular or similar arches have to be enumerated; for flat soffits 12 ins. wide and over the centres are given per foot super, and under 12 ins. wide per foot run giving the width. The costs of such items can be found by proportionate methods.

If it is possible for centres to be re-used for arches of equal size, then the cost can be distributed over the whole number.

SHORING.

The "Standard Method of Measurement" states that provisional quantities must be given for shoring, but as these will probably be given in feet cube, if actual costs are not available, it is necessary to take out rough quantities for a typical shore in order to arrive at a price. As an example, a raking shore for a building of four storeys is taken, consisting of 9″ × 9″ rakers, 9″ × 3″ plates, 11″ × 3″ sole-piece, 9″ × 1″ struts, 4½″ × 3″ needles. This shore is illustrated in Mitchell's "Building Construction" (Advanced), and permission has been given to use it.

Detailed Cost of Raking Shore.—

	£	s.	d.
130 ft. run of 9″ × 9″, at £45 7s. 6d. per standard or 5s. per foot cube = 3s. 1d. per foot run. .	£20	0	10
50 ft. run of 9″ × 3″, at £20 12s. 6d. per standard or 2s. 6d. per foot cube = 5½d. per foot run .			
9 ft. run of 11″ × 3″, at £20 12s. 6d. per standard or 2s. 6d. per foot cube = 7d. per foot run. .		5	3
6 ft. run of 4½″ × 3″, at £20 12s. 6d. per standard or 2s. 6d. per foot cube = 2½d. per foot run .			
54 ft. run of 9″ × 1″, at £28 17s. 6d. per standard or 3s. 6d. per foot cube = 2½d. per foot run		0 11	3
Cleats and folding wedges		0 2	6
Total cost of timber . .	£22	4	0
Add for waste, 5 per cent.		1 2	2
Cartage to job, 1¼ tons, at (say) £2 per ton .		3 10	0
Loading timber, 4 labourers, 3 hours, at 5s. .		0 15	3
Unloading at job, 4 labourers, 3 hours, at 5s.		0 15	3
Cutting holes for needles, bricklayer and labourer, 1 hour, at 2s. 11½d.		0 2	11½
Preparing timber, carpenter, 8 hours, at 1s. 8d.		0 13	4
Erecting shore, 4 labourers, 8 hours, at 5s. 1d.		2 0	8
Hoop-iron banding, ¼ cwt., at 10s. cwt. .		0 5	0
Ironmongery, nails, dogs, etc., ¼ cwt., at 15s. cwt.		0 7	6
Taking down, 4 labourers, 6 hours, at 5s. 1d.		1 10	6
Cartage to yard, as previous cartage item .		3 10	0
Unloading at yard, 4 labourers, 3 hours, at 5s. 1d.		0 15	3
	£37	11	10½
Less value of timber returned to store (say half cost only)		11 2	0
Total cost of shore	£26	9	10½

The total cubical contents of the timber detailed above amounts to 86 ft. 3 ins., and dividing the above total by 86 gives the price per foot cube of (say) 6s. 3d. As shoring timbers usually remain in position for a considerable time, the old timber is not of great value when returned to store.

A flying shore can be worked out in a similar manner to the above, and would cost less per foot cube, owing to the lighter timbers. If the shoring is built up with laminated timbers, such as 9″ × 3″, bolted together, the cost will be less.

Permanent Work.

Detailed Cost.—

" Fir in Lintels."—Assume timber at 2s. 8d. per foot cube. For this purpose assume as a typical example a lintel 5 ft. 4 ins. in length, and 9″ × 3″ section (i.e. 1 ft. cube) :—

	£	s.	d.
5 ft. 4 ins. of 9″ × 3″, at 2s. 8d. per foot cube	0		8
Waste, 5 per cent.	0		1¾
Cutting same, carpenter, 10 minutes, at 1s. 8d per hour	0	0	3¼
Cost per foot cube	£0	3	1

The fixing is done by the bricklayer, and as nothing is deducted from the brickwork for the space occupied by the lintel, nothing is added for the cost of fixing.

" Fir in Plates."—Assume timber at £20 per standard, or 2s. 5d. per foot cube, and as a typical case assume a room 16′ × 16′ which would require two plates :—

	£	s.	d.
32 ft. run of 4″ × 3″, at 2½d. per foot run.	£0	6	8
Waste, 5 per cent.	0	0	4
Carpenter, cutting and fixing, ½ hour, at 1s. 8d.	0	0	10
Labourer, hoisting, ¼ hour, at 1s. 3¼d.	0	0	3¼
Total cost	£0	8	1¾

The above plates contain 2¾ ft. cube, which, divided into the above total, gives the cost per foot cube as 3s. 0½d.

Framed Timbers.

All timbers must now be billed so that each scantling is given separately. In most of the following items the cost of labour and nails is calculated by taking a typical example which includes timbers of various dimensions, and afterwards this price per foot cube is added to the price of the timber. This method has been followed because the author considers that the operation of erecting a roof or a partition and similar items is one operation, and as far as costing is concerned, he is well aware that it is impossible for the workman to separate

the time spent on the timbers of different sizes when they are part of one job.

The "Southern" system of pricing per foot cube has been followed, but those wishing to follow the "Northern" system of pricing per foot run can readily adopt the cube price to the price per foot run by following the mental method explained in Chapter II.

If the reader wishes to check the dimensions for the roof truss and the trussed partition, he will find them illustrated in Mitchell's "Building Construction." They are used by kind permission of author and publishers.

"Fir Framed in Floors" in 2″ × 11″ and 3″ × 11″.—This item is more difficult, and it is necessary (in the absence of reliable prime costs) to take out the quantities for a typical floor. Assume a floor area 16′ × 16′, and that the joists are spaced 14 ins. centre to centre. If the joists are specified to be 2″ × 11″, then the trimmer and trimming joists must be 3″ × 11″. Assume timber at 2s. 6d. per foot cube.

	£	s.	d.
12 lengths, each 16 ft. of 11″ × 2″ = 192 ft. run, at 4½d.	£3	8	0
3/13 ft. 9 in. lengths of 11″ × 2″ (say) = 42 ft. run, at 4½d.	0	14	11
2/16 ft. or 32 ft. of 11″ × 3″, at 6½d.	0	17	4
1/5 ft. of 11″ × 3″, at 6½d.	0	2	8
	£5	2	11
Waste, 5 per cent.	0	5	2
Cost of material	£5	8	1
2 labourers, 2½ hours, hoisting, at 2s. 6½d.	0	5	11
Carpenter, fixing, 8 hours, at 1s. 8d.	0	13	4
Total	£6	7	4

If the whole of the timber contained in the foregoing example is cubed, it will be found to amount to a total of (approximately) 44 ft., and dividing the above total by 44 gives the price per foot cube of 2s. 10¾d. If nails are required, allow ⅛ lb. per foot cube.

It will be noticed that two scantlings, viz.: 11″ × 2″ and 11″ × 3″, are included in the above item; the relative proportion of 11″ × 3″ being so small, it is not considered necessary to separate the two sizes in this instance, especially as the price of the timber per standard is the same in this particular case.

Extra Labour in Trimming Joists for Hearths.—This is a new item in the "Standard Method of Measurement," and is worth 6 hours of carpenter's time, which at 1s. 8d. per hour equals 10s. Any extra timber is included with the other floor timbers.

"Fir Framed in Roof."—A typical section of a roof 40 ft. long with rafters 10 ft. 6 ins. in length would contain the following, viz. :—

72 rafters, each 10 ft. 6 ins. = 756 ft. run.
41 ft. run of ridge (to allow for one scarf).
82 ft. of purlins (to allow for two scarfs).
36/8-ft. collars = 288 ft. run.
72/4-ft. struts = 288 ft. run.

The cost of labour will be as follows :—

	£	s.	d.
2 labourers, hoisting, etc., 8 hours, at 2s. 6½d.	1	0	4
2 carpenters, cutting, shaping and fixing, 32 hours, at 3s. 4d.	5	6	8
Add for nails, 15 lbs., at 3d.	0	3	9
Cost of roof (labour and nails only)	£6	10	9

The whole of the timber in the roof amounts to 89 ft. cube, and dividing the above total by this figure gives the price per foot cube of 1s. 5¾d. This must be added to each item of timber.

In the Bill of Quantities the following items would be given :—

(*a*) "Fir framed in purlins" in 4″ × 6″.
(*b*) "Fir framed in roof in ridge" in 2″ × 7″.
(*c*) "Fir framed in roof, in rafters, collars and struts" in 2½″ × 4″.

Assume 4″ × 6″ at £22 per standard; 2″ × 7″ at £26 per standard, and 2″ × 4½″ at £30 per standard, the respective figures per foot cube are : (*a*) 2s. 8d., (*b*) 3s. 2d., and (*c*) 3s. 8d., but 5 per cent. must be added for waste, which gives 2s. 9½d., 3s. 3¾d., and 3s. 10d. respectively. Adding 1s. 5¾d. to each of the items the following prices are obtained :—

"Fir framed in purlins" (in 4″ × 6″), 4s. 3¼d. per foot cube.
"Fir framed in ridge" (in 2″ × 7″), 4s. 9½d. " " "
"Fir framed in rafters, strut and collars" (in 2″ × 4½″), 5s. 3¾d. per foot cube.

From these figures it will be noticed the timbers of small scantlings can in some cases cost more per foot cube than some others of larger scantlings, and for confirmation of this the reader is referred to the timber tables in Chapter II. In point of fact it would be cheaper at the present moment to use 4″ × 7″ timber instead of 4″ × 6″ for purlins.

Scarfed Joints.—In connection with the roof items the Bill of Quantities would give scarf joints as numbered items, and the following are submitted :—

"Labour to Scarfed Joint" to purlin (4″ × 6″), carpenter, 3½ hours.

"Labour to Scarfed Joint" to ridge (2″ × 7″), carpenter, 1½ hours.

"Fir Framed in Roof Truss."—This can be worked out in a similar manner to the preceding items. For an example, assume a king-post truss for a span of 24 ft. in the clear, and about 7 ft. in height, with timbers of the following scantlings, viz.: Tie-beam, 4½″ × 11″; king-post out of 4½″ × 8″; struts, 4½″ × 3″; principals, 4½″ × 6″.

The following timbers will be required :—

27 ft.	10 ins.	run of	4½″ × 11″
6 „	10 „	„	4½″ × 8″
27 „	10 „	„	4½″ × 6″
11 „	8 „	„	4½″ × 3″

The cost of labour will be as follows :-

2 carpenters framing, 20 hours, at 3s. 4d.	£3	6	8
1 labourer assisting, 5 hours, at 1s. 3½d.	0	6	4
	£3	13	0

This truss contains 17½ cub. ft., which gives the cost of labour per foot cube as 4s. 2d.

The following are the approximate present prices per standard, viz.: 4½″ × 11″, £26; 4½″ × 8″, £25; 4½″ × 6″, £22; 4½″ × 3″, £20, and adding 5 per cent. for waste gives: (*a*) 4½″ × 11″, 3s. 3½d.; (*b*) 4½″ × 8″, 3s. 2d.; (*c*) 4½″ × 6″, 2s. 8d.; (*d*) 4½″ × 3″, 2s. 6½d.

The following, therefore, are the prices per foot cube of the various members :—

Tie-beam, 4½″ × 11″	£0	7	5¾
King-post, 4½″ × 8″	0	7	4
Struts, 4½″ × 3″	0	6	11¼
Principals, 4½ × 6″	0	6	8½

If the whole of the timbers in the truss were machine-planed, the prices can be obtained from Tables I. and II., in Chapter II., and adding 5 per cent. for waste, the cost of the various members would be :—

Tie-beam, $4\frac{1}{2}'' \times 11''$	£0	7	$11\frac{1}{2}$
King-post, $4\frac{1}{2}'' \times 8''$	0	7	$10\frac{1}{2}$
Struts, $4\frac{1}{2}'' \times 3''$	0	7	9
Principals, $4\frac{1}{2}'' \times 6''$	0	7	$2\frac{1}{2}$

Hoisting Roof Truss.—In connection with the item of roof truss there would be a separate item for hoisting, and the costs of this would depend upon the height. If the building is three storeys high, allow two labourers 3 hours each, and for other heights in proportion.

Labours, etc., on Roof Truss.—If the $4\frac{1}{2}'' \times 11''$ cannot be obtained in one length, a scarfed joint will be necessary, and for this allow for carpenter 4 hours. Cleats would be required which are worth about 9d. each. The fixing of stirrup strap is worth $2\frac{1}{2}$ hours ; a pair of three-way straps $1\frac{1}{2}$ hours, and bolts, $\frac{3}{4}$ hour each.

"Fir Framed in Trussed Partitions."—The timber would be given in the different scantlings in the Bill of Quantities, and the costs can be worked out as described in the previous item for " Fir framed in Roofs."

Assume a typical trussed partition for a span of 20 ft. and for a height of 10 ft., and with members as follows : Sill and head, $4\frac{1}{2}'' \times 8''$; tie-beam and side posts, $4\frac{1}{2}'' \times 6''$; door posts, side braces and centre brace, $4\frac{1}{2}'' \times 4\frac{1}{2}''$; centre posts, $4\frac{1}{2}'' \times 7''$; straining head, $4\frac{1}{2}'' \times 3''$; studs, $2'' \times 4\frac{1}{2}''$, spaced at 14-in. centres.

The following timbers will be required :—

43 ft.	run of	$4\frac{1}{2}'' \times 8''$	
22 ,,	,,	$4\frac{1}{2}'' \times 6''$	
70 ,,	,,	$4\frac{1}{2}'' \times 4\frac{1}{2}$	
8 ,,	,,	$4\frac{1}{2}'' \times 7''$	
10 ,,	,,	$3'' \times 4\frac{1}{2}$	
134 ,,	,,	$2'' \times 4\frac{1}{2}$	

The cost of labour will be as follows :—

Framing and fixing, 2 carpenters, 20 hours, at 3s. 4d.	£3	6	8
Labour assisting, 10 hours, at 1s. $3\frac{1}{4}$d. . . .	0	12	$8\frac{1}{2}$
Nails, 9 lbs., at 3d.	0	2	3
Cost of partition (labour and nails only)	£4	1	$7\frac{1}{2}$

The whole of the timber in the above trussed partition amounts to 36 ft. cube, and dividing by this figure gives the price per foot cube of 2s. 3¼d.

The Bill of Quantities would give the items in their various scantlings, and if the prices per standard are for 4½″ × 8″, £32 ; 4½″ × 6″, £32 ; 4½″ × 4½″, £30 ; 4½″ × 7″, £30 ; 3″ × 4½″, £20 ; 2″ × 4½″, £30, adding 5 per cent. for waste gives the following prices per foot cube :—

(*a*) 4½″ × 8″, 4s. 1d. ; (*b*) 4½″ × 6″, 4s. 1d. ; (*c*) 4½″ × 4½″, 3s. 10¼d. ; (*d*) 4½″ × 7″, 3s. 10¼d. ; (*e*) 3″ × 4½″, 2s. 6½d. ; (*f*) 2″ × 4½″, 3s. 10¼d.

If the labour cost is added, the following items are obtained :—

Fir framed in trussed partitions :—			
in 4½″ × 8″ per foot cube	£0	6	4¼
in 4½″ × 6″ ,,	0	6	4¼
in 4½″ × 4½″ ,,	0	6	1½
in 4½″ × 7″ ,,	0	6	1½
in 3″ × 4½″ ,,	0	4	9¾
in 2″ × 4½″ ,,	0	6	1½

"Fir Framed in Quarter Partitions (*tenoned*)."—For a typical example assume a partition of similar length and height to the partition given in the last example, and with members as follows : Sill, head and frame, 4″ × 3″ ; studs, 4″ × 2″, spaced at 15-in. centres.

The following timbers will be required :—

74 ft. run of 4″ × 3″
170 ,, ,, 4″ × 2″

The cost of labour and nails will be as follows :—

Framing and fixing, 2 carpenters, 8 hours, at 3s. 4d.	£1	6	8
Nails, 6 lbs., at 3d.	0	1	6
Cost of partition (labour and nails)	£1	8	2

The timber in this partition amounts to 15¾ ft. cube, which, divided into £1 8s. 2d., gives the price per foot cube of 1s. 9¼d. If 4″ × 3″ is taken at 2s. 6½d., and 4″ × 2″ at 3s., the prices will be :—

Fir framed in quarter partition :—			
in 4″ × 3″ per foot cube	£0	4	3¾
in 4″ × 2″ ,,	0	4	9¼

The previous prices of timber allow per cent. for waste, and are based upon some of the preceding examples.

Nogging Pieces.—In connection with stud partitions, there will be an item for "nogging pieces." These are measured over the studs which allows for waste, and are usually 4″ × 3″. If the figure of 2s. 6d. is taken for 4″ × 3″, the price of 2½d. per foot run is found (by mental arithmetic as described in Chapter II.), for material only. For labour allow for one carpenter to fix 10 ft. per hour, which gives a total of 4½d. per foot run.

Boardings.—The only boarding dealt with in this trade is rough boarding as used for roofs, etc. Other boardings are described in "Joiner." Boardings are sold by the square of 100 ft. super, but large purchasers obtain 105 ft. super per square.

Detailed Cost.—

Rough Boarding, 1 in. Thick, *laid to Roof Slopes.*—

	£	s.	d.
1 square of 1-in. boarding, at 19s. 6d. delivered .	0	19	6
Waste, allow 10 per cent. for this work . .	0	1	11½
Carpenter, fixing, 4 hours, at 1s. 8d. . . .	0	6	8
Labourer, hoisting, etc., 1½ hours, at 1s. 3½d. .	0	1	10½
Allow for cutting splayed edge, 10 ft. per square, ½ hour, at 1s. 8d.	0	0	5
3½ lbs. of 2-in. nails, at 3d.	0	0	10½
Price per square	£1	11	3½

Boardings Traversed for Lead, Zinc, or Copper.—To the above add for one carpenter, 2 hours per square.

Firring to Falls.—This is often specified in connection with roof boarding and similar items. Assume for a typical example that one square of boarding is to be nailed upon firring pieces, which are to be spiked to joists spaced 15 ins. centre to centre and to be cut out of 3″ × 2″ timber. Timber assumed at 3s. per foot cube.

Detailed Cost.—

	£	s.	d.
90 ft. run of 3″ × 2″, at 1½d.	£0	11	
Nails, 2 lbs. at 3d.	0	0	
Carpenter, cutting to shape and fixing, 5 hours, at 1s. 8d.	0	8	
Price per square	£1	0	1

If the average depth of firrings are more than 2 ins. deep, then the item would be billed per foot run. The price of the

timber can be calculated as before described. Allow for carpenter fixing 12 ft. per hour.

Soffit Boarding.—1-in. wrought soffit boarding at eaves, spiked to rafters.

Assume eaves 1 ft. 8 ins. wide and 60 ft. in length.

	£	s	d
1 square of 1-in. boarding, at 21s. per square	£1	1	0
Add for waste, 15 per cent.	0	3	2
Add for shot edges (say) 60 ft. run, at ½d.	0	2	6
Fixing, 2 carpenters, 4 hours, at 3s. 4d.	0	13	4
Add, 1 labourer assisting, 4 hours, at 1s. 3½d.	0	5	1
Nails, 3½ lbs., at 3d.	0	0	10½
Price per square	£2	5	11½

Dividing the above by 100 gives the price per foot super of 5½d.

If the boarding is less than 18 ins. wide, it is billed per foot run, and the item then includes bearers. In these cases the prices can be found by proportionate methods, and for bearers add 10 per cent.

Fascias.—7″ × 1″ wrought and chamfered fascia boarding spiked to rafters.

Assume eaves as last item, i.e. 60 ft. run and timber at 3s. per foot cube.

	£	s	d
60 ft. run of 7″ × 1″, at 1½d.	£0		
Waste, 5 per cent.	0		
Chamfer and shot edge (by machinery), 60 ft., at ½d.	0		
Fixing, carpenter, 2½ hours, at 1s. 8d.	0		
Nails, 1 lb., at 3d.	0		
	£0	14	10

Dividing by 60 gives the price per foot run of 3d.

For *Mitres* on the above, allow the value of 1 ft. of fascia for each.

All fascias are priced per foot run.

Barge Boards.—11″ × 1¼″ wrought and chamfered barge boards.

Assume barge boards are fixed to a gable end of a building, and that each length is 15 ft. Timber at 4s. per foot cube.

	£	s	d
30 ft. run of 11″ × 1¼″ deal, at 4½d.	£0	11	10½
Waste, 5 per cent.	0	0	7
Allow for chamfer and shot edge (by machinery), 30 ft., at ½d.	0	1	3
Fixing, carpenter and labourer, 3 hours, at 2s. 11½d.	0	8	9¾
Nails, ¾ lb., at 3d.	0	0	2¼
Total cost	£1	2	8½

Dividing the above by 30 gives the price per foot run of (say) 10d.

For Mitres on the above, allow for carpenter 1½ hours each.

For Cut and Shaped Ends to ditto, allow carpenter 1 hour each, and add for any extra timber.

All barge boards are billed per foot run.

Gutter Boarding.—This item has to include all bearers, and is billed per foot run if 9 ins. wide and under, and per foot super if over 9 ins. wide. For a typical example, assume a length of 10 ft. with width at sole of 12 ins. on and including 2″ × 2″ bearers.

Detailed Cost.—

	£	s.	d.
30 ft. super of 1-in. boarding, at 2½s. per square	0	6	3
10 ft. run of 2″ × 2″, at 1½d. . . .	0	1	3
1 lb. of 2 in. nails, at 3d.	0	0	3
Carpenter, fixing, 6 hours, at 1s. 8d. . .	0	10	0
	£0	17	9

Dividing the above by 30 gives the price per foot super of 7d.

The cost per foot run can be found by proportion, adding 10 per cent. for the work being in narrow widths.

Forming Cesspool.—In connection with the last item there may be an additional item for forming cesspool. Allow for any extra material at the price found in last item, and add for the extra labour 5 hours for carpenter.

Tiling or Slating Battens.—Allow for carpenter fixing 2 hours per square and 1¼ lbs. of nails.

Battens Plugged to Walls.—Allow for carpenter 3 hours per square and 1¼ lbs. of nails.

Floor Fillets in Concrete.—To the cost of material allow ¾d. per foot for forming chamfers both sides. There will be no labour to add, as this is done by labourers when laying the concrete floors.

Centering for Ordinary Concrete.—This is detailed in "Reinforced Concrete Engineer," but for small detached items, allow for carpenter ¼ hour per foot super.

Oak Fencing.—Oak pale fencing, 5 ft. 6 ins. high, with 6″ × 4″ posts, 6 ft. out of ground and charred butts 2 ft. in ground; 6″ × 1¼″ gravel boards; arris rails out of 3″ × 3″, with cleft oak pales, fixed in bays 10 ft. long.

Assume a typical length of 30 ft.

Detailed Cost.—

	£	s.	d.
24 ft. run of 6″ × 4″ oak, at 9d.	0	18	0
30 ,, 6″ × 1¼″ oak, at 3d.	0	7	6
60 ,, arris rail out of 3″ × 3″, at 3¾d.. .	0	18	9
140 oak pales, each 5 ft. 6 ins. long, at 66s. per 100	4	12	4
Sheridised fencing nails, 3 lbs., at 6d. . . .	0	1	6
	£6	18	1
Add waste, 5 per cent.	0	6	11
Labourer, digging holes, 3 hours, at 1s. 3½d. . .	0	3	9¾
Carpenter, preparing and forming mortices, 1½ hours, at 1s. 8d.	0	2	6
Fixing, carpenter and labourer, 4 hours, at 2s. 11¼d.	0	11	9
Total cost of three bays . . .	£8	3	0¾

Dividing the above price by 10 gives the price per yard run of 16s. 3d.

The above figure is based upon the following prices for oak, viz.: Posts, 4s. 6d., gravel boards, 4s. 9d., arris rails, 5s. per foot cube, and cleft pales at 66s. per 100. Sawn pales would cost 38s. per 100.

Deal Fencing.—Deal fencing can be worked out in a similar manner to the last item. The timber would cost about 2s. 9d. per foot cube, and the deal weather boarding out of 1-in. fir would cost 13s. per square.

Fencing contractors employ men used to this class of work, and purchase their material in large quantities; in consequence this work is usually less expensive if sub-let.

Metal Lathing.—Expanded metal lathing is used to a considerable extent, especially for casing beams and stanchions, and the carpenter fixes the material, if "blocking out" is necessary.

It is sold in sheets of 2 yds. super which cost about 2s. each, but it can be obtained in narrow widths also.

Detailed Cost.—

Expanded Metal Lathing to large areas.—

	£	s.	d.
1 yd. super expanded metal. .	0		0
Add for waste in cutting, 7½ per cent.	0		1
Galvanised staples, ½ lb., at 6d. .	0		1½
Carpenter, fixing, ¼ hour, at 1s. 8d.	0		5
Cost per yard super	£0	1	7½

If the material is for casing beams and stanchions, the allowance for waste must be increased by 15 per cent. to 20 per cent.

Detailed Cost.—

Expanded Metal Lathing in beams or stanchions.—

Block out and encase B.S. beam with expanded metal lathing.

Assume a beam 15″ deep and 6″ wide for a span of 12 ft., with blocking pieces at 18″ centres.

	£	s	d
No. 18 fir blocking pieces (14″ × 2″ × 2″), at 1½d.	0	1	10½
4 yds. super expanded metal, at 1s. . .	0	4	0
Add for waste in cutting, 20 per cent. . .	0	0	9½
Galvanised staples, 1 lb., at 6d. . . .	0	0	6
Carpenter, fixing, 2 hours, at 1s. 8d. . .	0	3	4
	£0	10	6

Dividing by 36 gives the price per foot super of 3½d.

Tile Battens and Nails.—The total running length of battening per square depends upon the gauge of the tiling. To find the amount required, divide the gauge (in inches) into 120 ins., i.e. the length of a square, and multiply this number by 10 ft. It will be found, therefore, that tiles laid to a gauge of 3½ ins. require 340 ft. of battening, and tiles laid to 4-in. gauge require 300 ft. The battens will require nailing, and one nail every foot should be sufficient; there are 270 cut clasp 1½-in. nails to the pound, and 125 of 2-in. ditto.

CHAPTER XI.

JOINER (AND IRONMONGERY).

Joiner.—Usually this is the longest section of a Bill of Quantities, as the measurement of joinery work must be fully described. More variation in prices occurs in this trade than in any other, as so much depends upon the machinery available, shop management, and the size and standing of the firm. From the estimating point of view, the work of a joiner may be divided into two portions, viz. : (*a*) Work executed upon the job ; and (*b*) work executed in the shop (i.e. articles manufactured which merely require fixing). In the latter category very often the price has to include fixing on the job, as well as the actual cost of manufacture. In the first group (*a*) are floors, skirtings, boardings, and similar items ; and the second group (*b*) includes such items as doors, frames, staircases, fitments, framings, mouldings, and many other articles. The work in this trade is further sub-divided because work in oak, mahogany or any other timber has to be kept separate from work in deal. In Chapter X. on carpentry, the principal difference between the joiner and carpenter is noted, and a student will be well advised to turn back to Chapter II. and refresh his memory regarding the method of arriving at a price per foot super and per foot run, from the price per foot cube, for this is the most simple method of pricing joinery.

Basic Price of Timber.—The first procedure is to find a basic price for the timber, and to the actual cost of the timber must be added the cost of cartage, unloading, and handling. For joinery it is also necessary to add the cost of planing and preparing, i.e. finishing-off so as to be suitable for the purpose required. In Chapter II. it was found that the cost of timber averaged 3s. 2d. per foot cube, but for actual estimating the proper procedure is to obtain factory costs, by taking an average for a definite period of (say) twelve months. Tables

for all scantlings of wrought timber must be prepared as shown in Chapter II. In a small works containing a circular saw bench, a thicknessing and planing machine, and a "general joiner," all driven by electricity, it was found that the average cost of "preparing," including handling, cost 1s. 4d. per foot cube, and this figure, added to the previous cost, gives a basic price of 4s. 6d. per foot cube for the prepared material. This price will be taken as a datum for various calculations which follow in this chapter, but it must be borne in mind that the price of timber locally, and the actual average costs as ascertained in the particular shop, must be obtained by the Estimating Surveyor himself. The price of 4s. 6d. is assumed as a convenient figure, but if the student refers to the tables previously given, he will find the prices vary with different scantlings, and that it is impossible to accept a figure per foot cube for timber of all dimensions, and for all purposes.

Waste.—An allowance varying from 5 to 15 per cent. is made in the detailed costs which follow, nothing is allowed for waste in planing because joinery as fixed is always slightly smaller than specified.

Preparation of Hardwoods.—The preparation of hardwoods will be found to work out at about 12½ to 25 per cent. more than deal.

Work on Site.

Floors.—Prepared flooring is sold by the square, which is presumed to be 100 ft. super, but this is not quite correct as will be seen later. Floors are frequently specified to be in certain widths, and there are several "widths" on the market. Boards 7½ ins. wide and over are termed "deal widths," boards 5 ins. to 7 ins. are "batten widths," and boards under 5 ins. are termed "narrow widths." Flooring is priced per "square" in the South of England, and per yard super in the North. In the detailed costs which follow, the unit used is the square; to obtain the price per yard super, multiply by 9 and divide by 100.

Laying Flooring.—The following table gives the time spent by a joiner in laying flooring in "batten widths" in various kinds of work and at different thicknesses. If boards are in "deal widths" deduct 33⅓ per cent. from the table. If boards are in "narrow widths," add 50 per cent. to the table.

If boards are grooved and tongued, add one-third to the time allowance. The figures represent hours in joiner's time :—

Thickness of Boards.	Small Houses.	Ordinary Houses.	Large Jobs.
1 in.	4½ hours	4 hours	3 hours
1¼ ,,	4¾ ,,	4½ ,,	4 ,,
1½ ,,	5 ,,	4¾ ,,	4¼ ,,
2 ,,	5¼ ,,	5 ,,	4½ ,,

Waste in Flooring.—It is necessary to consider two factors with regard to waste. In the first place, the boards are slightly less in width than specified ; for example, a plain board described as "6 ins." wide is actually 5¾ ins. when laid. A tongued and grooved board "6 ins." wide will not measure more than 5½ ins. when laid.

If a typical area of 10′ × 10′ is considered, i.e. one "square," it will be seen that if every board which is described as 7 ins. wide loses half an inch, the total loss in a distance of 10 ft. is 8½ ins. If this loss is multiplied by 10 ft., it will be found that 7 ft. 1 in. super of boarding is required to make up the "square" of 100 ft. super, which represents 7 per cent. It is obvious that boards of narrow width necessitate a greater allowance for waste than those of greater width owing to the greater number of boards in the "square."

The second factor which causes waste occurs in laying the boards, owing to "short ends" due to fitting up to walls, around chimney breasts and hearths, and similar items.

The following total allowances for waste are suggested, viz. :—

	Plain.	Tongued and Grooved.
"Deal" widths	7½ per cent.	12½ per cent.
"Batten" ,,	10	15 ,, ,,
"Narrow" ,,	15	20 ,, ,,

Sometimes timber is sold by the "customary square," which varies in accordance with the width of the boards, and with boards of large widths works out at 105 ft. cube, an addition of 5 per cent. This "customary square" is not in use in all districts.

At the time of writing, the prices of plain floor boards range from 16s. to 32s. per square, and for tongued and grooved boards, 20s. to 34s. per square.

Nails.—The size of the nails depends upon the thickness of the boards; 1-in. boards require 2½-in. nails, and 1½-in. boards require 3¼-in. nails. One hundred of the former weigh about 1½ lbs., and one hundred of the latter about 2 lbs., and making an allowance of 10 per cent. for waste gives the following table for boards 1-in. thick. For ⅞-in. boards, deduct 25 per cent., and 1½-in. boards add 50 per cent.

"Deal" widths	4½ lbs. per square
'Batten'	5¾
'Narrow'	7¼

Detailed Costs of Flooring, per Square and per Yard Super.—

1-in. Wrought Deal Plain Square Edged Flooring *in batten widths, laid complete, with splayed heading joints.*

	£	s	d
1 square of flooring (edges shot), delivered	1	0	0
Waste, 10 per cent.	0	2	0
Nails, 5½ lbs., at 3d.	0	1	4½
Labourer, taking boards to room, 1 hour, at 1s. 3½d.	0	1	3½
Carpenter, laying boards, 4 hours, at 1s. 8d.	0	6	8
Cost per square of 100 ft. super	1	11	3¾
Cost per yard super	0	2	10

1¼-in. Wrought Deal Tongued and Grooved Flooring *in batten widths, laid with splayed heading joints and secret nailed.*

	£	s	d
1 square 1¼-in. T. and G. flooring, delivered	1	7	0
Waste, 15 per cent.	0	3	10¾
Nails, 7 lbs., at 3d.	0	1	9
Labourer, taking boards to room, 1 hour, at 1s. 3½d.	0	1	3½
Carpenter, laying flooring, 6 hours, at 1s. 8d.	0	10	0
Cost per square	2	3	11
Cost per yard super	0	3	11½

1½-in. Deal Wrought Tongued and Grooved Flooring *in narrow widths, with splayed heading joints, laid upon dovetailed fillets, embedded in concrete (measured elsewhere), and including coating surface of concrete with mastic consisting of pitch and tar.*

	£	s	d
1 square of 1½-in. T. and G. flooring	1	13	6
Waste on ditto, 15 per cent.	0	5	0½
Nails, 12 lbs., at 3d.	0	3	0
Labourer, taking boards to room, 1 hour, at 1s. 3½d.	0	1	3½
Carpenter, laying ditto, 9½ hours, at 1s. 8d.	0	15	10
3½ galls. mastic, at 1s. 6d.	0	5	3
Labourer, spreading mastic, 2 hours, at 1s. 3½d.	0	2	6½
Price per square super	3	6	5½
Cost per yard super	0	5	11¾

Mitred Borders to Hearths.—In connection with flooring items, it is often found that oak mitred borders are specified. For the purpose of calculation, assume a hearth 4′ × 1′ 6″. Allow for forming rebate and fixing 4 ft. per hour. Oak assumed at 16s. 6d. per foot cube.

Detailed Cost of Oak mitred Border.—

	£	s.	d.
8 ft. run of 2½″ × 1¼″ oak, at 5d. per foot run . .	£0		
Sundries, 2½ per cent. (see later)	0		
Carpenter, fixing and forming rebate, 2 hours, at 1s. 8d.		3	4
	£0	6	9

Dividing by 8 ft. gives the cost per foot run of 10d.

Skirtings.—These are usually purchased already worked from the mill, but if the same have to be specially worked, then the cost must be worked out as described later for mouldings. Skirtings are sold per 100 ft. run, and 10 per cent. should be allowed for waste. In a Bill of Quantities the item includes any splayed grounds and backings, so that the cost of these must be included. Assume that the item reads 9″ × 1″ torus moulded skirting, then it is safe to assume that 3″ × 1″ splayed grounds with 1″ × 1″ fillets, and a backing piece every 3 ft. will be required; the cost of backing pieces would not be more than ¼d. each. For the purpose of a detailed cost, assume a room 18′ × 12′, requiring 60 ft. run of skirting. The rough timber is taken at 3s., and the wrought timber at 4s. 6d. per foot cube.

Detailed Cost of Skirting.—

	£	s.	d.
60 ft. of 3″ × 1″ rough splayed grounds, at ¾d.	£0	3	9
60 ft. 1″ × 1″ fillet, at ¼d. . .	0	1	3
20 rough deal backing pieces, at ¼d.	0	0	5
Waste on timber, 5 per cent. .	0	0	3
Nails, 1 lb., at 3d. . .	0	0	3
Carpenter, fixing rough timber, 8 hours, at 1s. 8d	0	13	4
Labourer, assisting, 2 hours, at 1s. 3½d. . . .	0	2	6½
60 ft. 9″ × 1″ torus moulded skirting, at 6d. per foot	1	10	0
Waste, 10 per cent.	0	3	0
Nails, ½ lb., at 3d.	0	0	1½
Carpenter, fixing skirting, 8 hours, at 1s. 8d.	0	13	4
Labourer, assisting, 2 hours, at 1s. 3½d.			6½
Total cost for room	£3	10	9½

Dividing by 60 gives the price per foot run of 1s. 2d.

Certain numbered items occur with skirtings, and the following allowances are suggested, viz. : fitted ends, equal to ½ ft. of skirting ; mitres, equal to 1 foot ; housings, equal to 1½ ft., and circular work (per foot), equal to 3 ft. of ordinary skirting.

Matchboardings.—Matchboarding is sold by the square, and the allowances for waste are exactly the same as described for flooring. At the time of writing the price of matchboarding varied from 17s. 6d. to 25s. per square.

Labour Fixing Matchboarding.—The labour fixing ordinary tongued and grooved matching is about the same for ⅝-in., ¾-in. or 1-in. boards, but it varies in accordance with the width ; the following are suggested per square :—

Boards 3 ins. wide and under, 4½ hours.
„ 4 ins. to 6 ins. wide, 4¾ „
„ over 6 ins. wide, 4 hours.

Unless the work is in short lengths, a labourer will be required to assist, but one labourer can attend upon two carpenters.

Detailed Cost.—

¾-in. Wrought Deal Prepared Matchboarding *in narrow (3-in.) widths fixed to Stud Partitions.*

	£	s.	d.
1 square ¾-in. prepared matching . .	0	19	0
Waste on ditto, 20 per cent. . . .	0	3	10
Nails (see Table for flooring), 5½ lbs., at 3d. .	0	1	4½
Carpenter, fixing, 4½ hours, at 1s. 8d. . .	0	7	6
Labour, assisting, 2¼ hours, at 1s. 3¼d. . .	0	2	10¼
Cost per square	£1	14	6¾
Cost per yard super	£0	3	2½

Plywood.—This material has become very popular. It can be used as a lining for walls and ceilings ; for panelling, for flush doors, and numerous other items such as door panels or drawer bottoms. It is obtainable in a great variety of widths and lengths and in different thicknesses from ⅛ to 1 in. Up to ¼-in. thick the material is frequently known as " three-ply," and up to ⅜-in. thick as " five-ply." The prices vary according to the quality and the class of wood, and the differences are so considerable that no prices can be quoted here.

The cost of fixing will depend upon the class of work, but an average datum is 2¼ minutes per foot super for one carpenter

for the three-ply boarding, and 3 minutes for the five-ply. If the work is on ceilings or sloping soffits, allow 2½ minutes, and for a labourer to assist the carpenter.

For waste allow 10 per cent. for ordinary work, and 15 per cent. if in panels.

For brads, allow about ⅛ ounce per foot super.

Plywood can also be obtained metal faced.

Insulating Boarding (or Pulp-board).—There are many patent boardings on the market, and the thickness and prices vary considerably.

At the present time the prices range from 1s. 6d. to 2s. 8d. per yard super.

For fixing to floors (i.e. laid over flooring to deaden sound), allow for carpenter 15 minutes per yard super. For fixing to walls, 20 minutes, and to ceilings, 22 minutes per yard super.

Allow for a labourer to assist if the work is to ceilings or sloping soffits. Allow 2 ounces of brads per yard super for ¼-in. boarding, and 4 ounces per yard for ½-in. boarding, and so on.

For waste allow 10 per cent.

If cover slips are specified (to cover joints), allow for carpenter to fix 100 ft. run in 3 hours.

Mouldings.—For accurate costs of mouldings as worked by machinery, it is necessary to obtain actual shop costs, and these should be worked out so that the cost per inch in girth can be obtained. For example, it was found in a certain shop that the cost per inch in girth worked out at ⅛d. per foot run, therefore a moulding 4 ins. in girth would be 2d. per foot run, whilst a moulding 6 ins. in girth would be 3d. per foot run. Other sizes can be obtained in a similar manner. The cost of fixing must be added as described below for dado and picture rails. Stock mouldings, however, are purchased ready made.

Dado Mouldings.—These are also sold per 100 ft., but if specially made to detail, the cost must be ascertained as described for ordinary mouldings. For fixing, allow carpenter 10 ft. per hour, and allow for one plug to every 3 ft. in length; plugs are worth about ½d. to 1d. each.

Detailed Cost of Dado Rail.—3½" × 1¼" wrought and moulded dado rail to detail including plugging to walls.

Assume cost of timber is 4s. 6d. per foot cube, and that the girth of this moulding is 5 ins. Assume a room of the same

size as that given in the example of skirting, giving a total of 60 ft. run.

	£	s	d
60 ft. run of timber, 3¾″ × 1¾″ (unmoulded), at 2d.	0	10	0
60 ft. run forming moulding, at 2½d. (i.e. ½d. per inch in girth)	0	12	0
Waste, add 5 per cent.	0	1	1½
Plugs, 21, at ½d. each	0	0	10½
Fixing, carpenter, 6 hours, at 1s. 8d.			
	£1	14	6

Dividing the above total by 60 gives the price per foot run of 7d.

Certain numbered items will occur, and the following allowances are suggested, viz. :—

Fitted ends, allow the cost of 1 ft. of moulding. Mitres, allow 2 ft., and for circular work per foot, allow 5 ft. of ordinary moulding.

Picture Mouldings.—These can be priced in a similar manner to dado mouldings. Allow for carpenter fixing 12 ft. per hour, and for plugs and waste as before described.

Detailed Cost of Picture Mouldings.—Assume a room of similar dimensions to preceding item, and assume a worked moulding is purchased at 6s. 6d. per 100 ft. run. It will be noticed that a stock moulding requires " cleaning off."

2-in. Stock moulded Picture Rail plugged to Walls.

	£	s	d
60 ft. run stock moulding, at 6s. 6d. per 100 ft.	0	3	10
Cleaning off ditto, carpenter, 1 hour, at 1s. 8d.	0	1	8
21 plugs, at ½d.	0	0	10½
Fixing, carpenter, 5 hours, at 1s. 8d.	0	8	4
	£0	14	8½

Dividing by 60 gives the price per foot run of 2¾d.

Numbered items will occur as detailed for dado rail, and the allowances are similar, except for circular work, which will perhaps necessitate a purpose made moulding, in which case allow per foot run the cost of 10 ft. of the ordinary moulding.

Manufactured Articles.

We now come to the very difficult question of pricing articles made in the shop, such as doors, windows (sashes and casements), and fitments generally. The pricing of these articles requires many years of experience, and a sound knowledge of quantity surveying, in order to understand what actually is

included in the item. Sometimes the unit by which the item in a Bill of Quantities is priced is of little use in working out the estimate. Many items are priced per foot super to include all labours and material, without any allowance for tenons, and in the case of sashes and frames the price per foot super has to include certain labours, but not others. Other articles, such as kitchen dressers and draining boards, are sometimes priced per number, often with a sketch attached and over-all sizes given. To price such items correctly, the Estimating Surveyor must take out special quantities of all material himself, but in a different manner to the Quantity Surveyor. In compiling prices, it must be noted that not only the actual making is to be allowed for, but also getting out the material, framing up, and perhaps fixing upon the job. In working out such items as doors, sashes, and frames, staircases and similar articles, it will be necessary to work out the total cost of a typical specimen and afterwards divide this amount by the number of superficial or running feet contained in the article so as to price the item as it is described in a Bill of Quantities. Many manufactured articles will require to be carted to the job and unloaded, this cost must be added to the item.

Sundries, Glue, Glasspaper, Small Wedges, etc.—To avoid unnecessary detail, it is usual to add a percentage to the cost of manufactured articles. In the example given later, 2½ per cent. is allowed for sundries.

Doors.—In the following examples, timber prepared for framing up has been calculated upon a basis of 4s. 6d. per foot cube. Many architects now specify ready-made doors, which if obtained from a firm of repute may effect a great saving in cost.

Making Doors.—The following table is submitted as a guide, and is based upon medium-sized doors, from 16 ft. super

Description of Door.	1 in.	1¼ in.	1½ in.	1¾ in.	2 ins.	2¼ ins.	2½ ins.
Ledged and braced .	2	2½	3	4	4	—	—
Framed and braced .	—	5½	5½	6	6	—	—
Square, two-panel .	—	6½	6½	6¾	6¾	8	8 hrs.
,, four-panel .	—	7	7	7¼	8	9	9½ ,,
,, six-panel .	—	7¾	7¾	8	8¼	10	10½ ,,

to 21 ft. super, and indicates the time taken by one joiner in preparing and making only. Fixing upon the job is given

separately. For doors over 21 ft. super and not exceeding 38 ft. super, add 25 per cent. to the table; for doors over 38 ft. super, add 33 per cent. to the figures. For dwarf doors (i.e. under 16 ft. super) deduct 25 per cent.

To the above the following allowances should be made :—

"Bead butt"—add 1 hour per side.
"Bead flush"—add 1½ hours per side.
Moulded one side—add 1½ hours.
Moulded both sides—add 3 hours.
Bolection moulded one side—add 2 hours.
Ditto, both sides—add 4 hours.
Double tenoned—add 1 hour.
Diminished stiles and glazing bars—add 4 hours.
Hung in pairs—add 1½ hours.
Hung folding—add 3 hours.

In measuring up the quantity of timber required in doors, it must be noted that allowance must be made for the timber for tenons.

Hanging Doors.—For cleaning-off and hanging doors on the job, allow for "ledged and braced doors" and for "framed and braced doors," 1 hour of carpenter's time. For other doors, allow for carpenter and for labourer assisting, 2 hours. For ordinary doors assume that one labourer can attend upon two carpenters, and for large doors allow one labourer to each carpenter; for doors hung in pairs, add 50 per cent. to the cost of labour. Nothing should be added for the fixing of locks or butts as the fixing is included in the ironmongery items.

Detailed Costs (not including Cartage, Loading or Unloading).

2-in. Deal Ledged and Braced Door, *faced with ¾-in. V-jointed Matching.*—Assume a door 2′ 8″ × 6′ 6″.

	£	s	d
2 ft. 8 ins. run of 4″ × 1¼″ (top ledge), at 1¾d.	0	0	4¼
5 ft. 4 ins. run of 9″ × 1¼″ (middle and bottom ledged), at 4¼d.	0	1	10¾
6 ft. 6 ins. run of 4″ × 1¼″, at 1¾d.	0	0	11¼
17 ft. 4 ins. super of ¾-in. matching, at 2d.	0	2	10¾
Waste on material, 10 per cent.	0	0	7½
Nails, 1 lb., at 3d.	0	0	3
Making, joiner, 4 hours, at 1s. 8d.	0	6	8
Sundries, 2½ per cent.	0	0	4
Hanging on job, carpenter, 1 hour, at 1s. 8d.	0	1	8
Cost of 1 door	£0	15	8

Dividing the above total by 17⅓ gives the price per foot super of 11d.

1½-in. Deal framed square Four-panel Door, *with planted mouldings both sides, and double tenoned for mortice lock.*—Assume a door 2′ 8″ × 6′ 6″.

18 ft. 4 ins. run of 4½″ × 1½″ prepared (stiles and muntins), at 2½d.	£0	3	9¾
5 ft. 4 ins. run of 9″ × 1½″ (middle and bottom rails), at 5d.			2½
2 ft. 8 ins. run of 4½″ × 1½″ (top rail), at 2½d.			6¾
8 ft. super of ¾-in. wrought boarding (panels), at 4d			8
54 ft. run of panel moulding, at 1d.			6
Waste on material, 10 per cent.			4½
Joiner's time making, 11 hours, at 1s. 8d.	0	18	4
Sundries, 2½ per cent.	0	0	7
Hanging, cleaning-off, etc., carpenter, 2 hours, at 1s. 8d.			4
Labourer, assisting, 1 hour, at 1s. 3½d.			3½
	£1	18	7¾

Dividing the above total by 17⅓ gives the price per foot super of 2s. 2¾d.

In the foregoing example ¾-in. boarding has been assumed for the panels, if desired plywood could be substituted which would reduce the cost of the panels.

2-in. Deal Wrought and Framed Three-panel Door *with diminished stiles, upper panel ovolo moulded and divided into six squares for glazing, with ovolo moulded sash bars, two lower panels bead-butt, lock rail double tenoned for mortice lock.*—Assume a door 6′ 8″ × 2′ 8″, i.e. 17 ft. 9 ins. super.

15 ft. 7 ins. run of 4½″ × 2″ prepared (stiles and muntins), at 3½d.	£0		6½
5 ft. 4 ins. run of 9″ × 2″ (rails), at 6¾d.	0		0
2 ft. 8 ins. run of 3″ × 2″, at 2½d.	0		5¾
4 ft. 4 ins. super of prepared boarding (panels), at 4½d.	0		7¼
11 ft. 6 ins. run of glazing bars out of 2″ × 1″, at ¾d. plus moulding equal to 4-in. girth, at 2d.—totals 2¼d. per foot run	0		7¾
8 ft. run forming bead, equal to moulding, ¾-in. girth, at ½d.	0		
10 ft. run forming ovolo mould on solid, say 2-in. girth, at 1d.	0	0	10
	£0	13	5¼
Waste on material, 10 per cent.	0	1	4
Carry forward	£0	14	9¼

	Brought forward .	£0	14	9½
Making, joiner . . .	8 hours (as table)			
Add for bead butt . .	1 hour			
,, ,, diminished stiles .	4 hours			
,, ,, double tenons .	1 hour			
	14 hours, at 1s. 8d.	1	3	4
		£1	18	1½
Sundries, 2½ per cent. . . .		0	0	11½
Cost of making door in shop		£1	19	0½
Cleaning-off, fitting and hanging, carpenter, 2 hours, at 1s. 8d.		0	3	4
Labourer, 1 hour, at 1s. 3½d.		0	1	3½
Total cost of door		£2	3	8

Dividing the above total by 17¾ gives the price per foot super at 2s. 5½d.

2¼-in. Deal Six-panel Door *with raised and fielded panels, bolection moulded one side and planted mouldings inside, hung in pairs, and with rebated and beaded meeting stiles, double tenoned for mortice lock.*

45 ft. run of 4″ × 2¼″ prepared (stiles and head), at 3¾d.	£0	14	0¾
8 ft. 6 ins. run 9″ × 2¼″ (rails), at 7¾d. . . .	0	5	5¾
15 ft. 6 ins. super 1⅛-in. wrought boards (panels), at 7¾d.	0	10	0
34 ft. forming sinkings on panelling, equal to a moulding 5-in. girth, at 2¾d.	0	7	1
34 ft. run bolection moulding (purchased ready made), at 2d.			8
No. 24 mitres on ditto, at 2d.			0
34 ft. run small moulding, at ¾d.			1½
7 ft. run form rebate and bead, equal to moulding 3-in. girth, at 1½d.	0	0	10½
	£2	9	3½
Waste on material, add 10 per cent. . . .	0	4	11
	£2	14	2½
Making, joiner (as table) . . . 10 hours.			
Add for large doors, 25 per cent. . 2½ ,,			
,, ,, planted moulding side . . 1½ ,,			
,, ,, bolection moulded side . . 2 ,,			
,, ,, hanging in pairs . . . 1½ ,,			
,, ,, double tenons . . . 1 hour			
18½ hours at 1s. 8d.	1	10	10
Sundries, 2½ per cent. . . .	0	2	1½
Cost of making doors	£4	7	2
Cleaning-off, preparing and hanging, carpenter and labourer, 2 hours, plus 50 per cent. equals 3 hours, at 2s. 11½d.	0	8	9¾
Total cost	£4	15	11¾

Dividing the above by 28 gives the price per foot super of 3s. 5¼d.

Ready-made Panelled Doors.—The prices can be obtained from the makers' catalogues; they vary from 7s. 6d. to 12s. per door. Flush pattern doors cost from 21s. to 40s. each. The cost of cleaning-off and hanging must be added.

Trap Doors, Dwarf Doors, Panelling, Spandril Framings, can all be calculated in a similar manner to the various doors as described in the foregoing examples.

Solid Door Frames.—These are not difficult to price. The cost of manufacture and forming the rebate only need be considered, as the fixing is done by the bricklayer. The rebating and beading is usually done by machinery. Assume a frame for a typical opening for a door 6′ 8″ × 2′ 8″. Allowing for four "passings" of 3 ins. each and 2 horns of 3 ins. each, it will be found that the total length of timber is 17 ft. 6 ins. (or 17½ ft.).

Detailed Cost.—Deal solid frame out of 4½″ × 3″, rebated and beaded.

	£	s.	d.
17 ft. 6 ins. run of 4½″ × 3″, at 5d.	0	7	3½
Waste on timber, 10 per cent. .	0	0	8¾
Joiner's time, 2 hours, at 1s. 8d. .	0	3	4
Sundries, 2½ per cent. . . .	0	0	3½
Cost of frame	£0	11	7¾

Dividing the above by 17½ gives the price per foot run of 8d.

Panelled Jamb and Soffit Linings.—These are usually billed to include all wrought and framed grounds; to obtain the value of these grounds, the timber must be measured up and priced. For the joiner's time, allow one quarter of the time allowed in the table for panelled linings. The following table is based upon a typical opening in a 14-in. wall for a door

Descriptions of Linings.	Joiner's Time per Opening.		
	Size: 1 in.	1¼ in.	1½ in.
Square. . . .	2¾ hours	3 hours	3 hours
Once rebated . .	3 ,,	3¼ ,,	3½ ,,
Twice ,, . .	3¾ ,,	3½ ,,	4 ,,
Square panelled . .	—	10 ,,	10 ,,
Square moulded . .	—	10¼ ,,	10¼ ,,

2′ 8″ × 6′ 6″, the superficial area of linings is 21 ft. 4 ins., so to obtain the price per foot super, divide by this figure. The time varies so very little for 9-in., 14-in., or 18-in. linings that it can be ignored.

The method of arriving at a price per foot super is exactly similar to the method used for doors.

Detailed Cost.—Wrought Deal 1½-in. framed panelled jamb and soffit linings, including plain 1-in. backings.

	£	s	d
36 ft. run, 4½″ × 1½″, at 2½d.	0	8	3
4 ft. run, 9″ × 1½″, at 4½d.	0	1	7
5 ft. 3 ins. super ¾-in. wrought (panels), at 3½d.	0	1	5
38 ft. run panel moulding, at ¾d.	0	2	4½
18 ft. 8 ins. super 1-in. backings, at 2¾d.	0	4	3½
Waste on material, 10 per cent.	0	1	9¾
Joiner's time, 10½ hours, at 1s. 8d. (See Table.)	0	17	1
Ditto on backings (see above), 2½ hours, at 1s. 8d.	0	4	2
Sundries, 2½ per cent.	0	1	0½
Total cost	£2	2	0½

Dividing by 21½ as described above gives the price per foot super of 1s. 11¼d.

In the above example, the price of rough timber has been taken at 3s. 6d., and the wrought timber at 5s. 6d. per foot cube.

Plain Jamb and Soffit Linings.—These are now billed per foot run whatever the width. The time taken for plain linings 11 ins. wide and under is the same, viz. :—

1-in. thick, 2 hours ; 1¼-in. thick, 2¼ hours, and 1½-in. thick, 2½ hours per opening (i.e. for a door, 2′ 8″ × 6′ 6″).

Assume a lining for a typical opening as described with 1¼-in. material. Allowing for four "passings" of 1¼ ins. each, it will be found that the total length of the material required is 16 ft. 5 ins. (say 16½ ft.).

Detailed Cost.—

	£	s	d
10″ × 1¼″ wrought deal plain framed linings, 16′ 6″ run of 10″ × 1¼″, at 5d.	0	6	10½
Waste on timber, 10 per cent.	0	0	8¼
Joiner's time, 2¼ hours, at 1s. 8d.	0	3	9
Sundries, 2½ per cent.	0	0	3¼
	£0	11	7

Dividing by 16½ gives the price per foot run of 8¼d.

Wrought and Splayed Grounds (*as for Architraves, etc.*).—These are billed per foot run, and for a typical door opening as shown in the previous example, allow for joiner's time, 1 hour. Measure up the timber for a typical opening, and reduce to a price per foot run.

Architraves.—To the cost of material, usually supplied at a price per 100 ft., add for fixing all as described for dado rail.

Windows.—Casements and frames are fairly simple to price, but double-hung sashes and frames are extremely complicated ; the detailed prices will explain the methods used.

Casements.—

Detailed Cost.—2-in. Deal rebated and moulded casement —hung on butts, and in one sheet for glazing.—Taking as a typical example a casement 2′ × 3′, or 6 ft. super, the following will occur :—

	£
2 ft. run of 4″ × 2″, at 3d. per foot run	0
8 ft. run of 3″ × 2″, at 2½d. ,, ,,	0
Waste on timber, 10 per cent. .	0
8 ft. forming moulding and rebate (equal to 2½ ins at ½d.), at 2½d. . . .	0
Making, joiner, 4 hours, at 1s. 8d.	0
Sundries, 2½ per cent. . . .	0
Total cost . . .	£0 10 9

Dividing by 6 gives the cost per foot super of 1s. 9½d.

In the above example, the actual length of moulding and rebate is 7 ft. 10 ins., but 8 ft. has been taken for convenience.

Fixing and Hanging Casement.—In accordance with the 1935 Standard Method of Measurement, this item must now be enumerated separately. The time taken for adjusting and hanging a casement 6 ft. super, as described in the last item, would be 1 hour.

For other casements allow as follows :—

Over 6 ft. and not exceeding 8 ft. super	1¼ hours
,, 8 ft. ,, ,, 10 ft. ,,	1½ ,,
,, 10 ft. ,, ,, 12 ft. ,,	1¾ ,,

Casement Frames.—The cost of these can be calculated in a similar manner to solid door frames (see previous example). If the sill is of oak, it must be calculated separately. Allow for weathering, sinking, and grooving, 1½d. per foot run for every inch of girth of the labour.

French Casements.—These can be calculated in a similar manner to the casement previously described, and treat the frame as described for door frames, keeping oak sills separate.

If fitted with a transome light, treat this in a similar manner to a moulded casement.

Sashes and Cased Frames.—

Detailed Cost.—2-in. Deal double-hung sashes and cased frames with open sashes (to usual specification). Assume a typical frame 3′ × 6′ 6″ over all dimensions, with double hung sashes complete.

	£	s	d
Sashes, 3 ft. run of 4½″ × 2″, at 3½d.	0	0	10½
Sashes, 9 ft. run of 2″ × 2″, at 1½d.	0		1½
Sashes, 11 ft. 6 ins. of 2½″ × 2″, at 1¾d.	0		8
Sill, 4 ft. run, 6″ × 3″ oak, at 1s. 3d.	0		0
Head, 3 ft. 9 ins. of 5″ × 2″, at 3½d.	0		2
Linings, 32 ft. run of 4½″ × 1″, at 1¾d.	0		8
Back linings, 12 ft. run, 6″ × ½″, at 1¼d.	0		3
Stiles, 12 ft. 6″ × 1½″, at 3½d.	0		7¾
Parting slip, 10 ft. 2″ × ½″, at ¼d.	0		2½
30 ft. run beading, at ¼d.	0		3
Waste on timber, 10 per cent.	0		1
Making, joiner, 11 hours, at 1s. 8d.	0	18	4
Sundries, 2½ per cent.	0	0	7
	£2	1	10¼

Dividing this total by 19½ gives the price per foot super of 2s. 2½d. Sash fasteners and sash lifts are priced separately with the ironmongery.

Fixing Sashes and Cased Frames.—The 1935 Standard Method of Measurement states this must be given separately as a numbered item which is to include axle pulleys, sash weights, and sash line. The cost of fixing a cased frame and sashes as described in the previous item is as follows :—

Detailed Cost.—

	£	s	d
4 brass-faced axle pulleys, at 6d.	0	2	0
4 sash weights (8½ lbs. each), at 2s. 6d.	0	10	0
9 yds. sash line, at 3½d.	0	2	7½
Waste on ditto, 20 per cent.	0	0	6½
Fixing and fitting on job—			
Carpenter, 2 hours, at 1s. 8d.	0	3	4
Labourer assisting, ¾ hour, at 1s. 3½d.	0	0	11
Total cost per frame	£0	19	5

Sash Weights.—These are sold by weight, and the present price of cast-iron weights is 11s. per cwt. Lead weights are used for very heavy windows, and the present price is about 24s. per cwt. An ordinary sash such as last described requires two weights of 8½ lbs. Larger sashes would require heavier weights.

Sash Line.—This is sold by the " gross " which is one dozen " Knots " each containing 12 yds. The prices vary according

to size and quality, but a good quality strong line can be obtained at 42s. per gross. A generous allowance must be made for waste, say 20 per cent.

Sash Chains.—These are sometimes used instead of sash lines, and require stronger axle pulleys, and the price of a complete set of chains and pulleys for an ordinary window with 1¾-in. sashes is about 11s., and for 2-in. sashes 15s.

Window Boards.—These are kept separate from the windows. A cased frame as described in the last two items would require either a nosing or a window board. This item can be worked out as described in the paragraph on plain linings. The timber can be measured up and ½d. per foot run for every ½-in. girth of nosing can be added. Allow for making and fixing 2 hours for every foot super. The item is priced per foot run.

Window Linings and Architraves.—The cost of these can be ascertained from those given for door linings and architraves.

STAIRCASES.

These are somewhat complicated, but the following detailed costs will explain the methods. An allowance of 15 per cent. should be made for waste in this class of work.

Staircase in Deal, with 1¼-in. Treads and 1-in. Risers, rounded nosing, and moulding below same. Fixed on and including strong fir Carriages and Brackets.—Assume a typical staircase consisting of twelve actual treads and thirteen risers, with 9½-in. treads and 7½-in. risers, allow 1 in. for nosing and assume width is 2 ft. 4 ins. It will be found that a staircase of the above dimensions works out at 42 ft. super. All staircases are priced per foot super.

Detailed Cost.—

	£	s.	d.
27 ft. run of 12″ × 1¼″, at 5¾d. . . .	0	12	11¼
32 ft. run of 7½″ × 1″, at 2¾d. . . .	0	7	4
13 ft. run rough fir carriage, 6″ × 3″, at 4½d. (The last item is at 3s. per foot cube.)	0	4	10½
14 ft. run 7″ × 1½″ rough brackets, at 2d. .	0		
32 ft. run Scotia moulding, at 1d.	0		
No. 24 rough blocks, at ½d. each .	0		
Waste on timber, 15 per cent. .	0		
Allowance for rounded edges and grooves, 10 per cent. . .	0		0¾
1 lb. nails, at 3d.	0		3
Making and fixing, joiner, at 2½ hours per tread = 30 hours, at 1s. 8d.	2	10	0
Sundries, 2½ per cent. . . .	0	2	2½
Total cost . . .	£4	10	9

Dividing this by 42 gives the price per foot super of 2s. 2d.

It will be noticed that 2½ hours per tread have been allowed in the above price; for staircases of other sizes the following are suggested, viz. :—

Less than 3 ft. wide, allow 2½ hours per tread.
From 3 ft. to 4 ft., allow 2¾ hours per tread.
From 4 ft. to 6 ft., allow 3 hours. Others in proportion.

Bullnose or Curtail Steps.—Add for extra timber and allow for ordinary bullnoses 3 to 4 hours, and for curtail steps, 8 hours for joiner.

Winders.—Add for extra timber, and allow 2 hours extra for joiner's time.

Strings.—Take off as described for skirtings, but add 25 per cent. to the labour. If *wreathed,* add three times the price per foot run for the portion *wreathed*

Hand-rails.—These prices depend entirely upon the section, and must be priced accordingly. If mop-stick pattern, allow for joiner 10 minutes per foot and add material. If fully moulded, add ½d. per inch of girth per foot run and for fixing 15 minutes per foot run. If in hardwood add as described later.

Balusters.—These are priced per number. If plain, allow 10 minutes for joiner for each. If turned, take three times the price.

Sinkings for Balusters.—Allow 10 minutes of joiner's time for each.

Housings.—Allow ¼ hour each.

Newels.—The cost of these, like balusters and hand-rails, depends upon the pattern. If plain (out of 4″ × 4″), add to cost of timber 4 hours per newel for joiner. Turned newels cost about three times the value of plain ones.

Fitments.

Certain fitments are numbered and a sketch given, and the only safe method of pricing is to measure up the fitment in detail, as described for other joinery work, and assess the time in accordance with the class of job.

Kitchen Dresser.—As a typical example of a fitment for which a lump sum is required, a small dresser is detailed. Often the Quantity Surveyor gives a sketch as well as dimensions, then the price is easier to compile. Assume a dresser 5 ft.

wide and 8 ft. in height, with one large teak shelf 18 ins. wide, on 3″ × 3″ square legs; pot-board and skirting below; two drawers, three shelves, 6 ins., 7 ins., and 9 ins. wide respectively; 1-in. top and a moulding mitred round same; the whole framed and fixed complete.

Detailed Cost.—

	£	s.	d.
11 ft. run of 3″ × 3″ legs, at 3½d.	0	2	11¾
14 ft. run of 3″ × 2″ bearers, at 2½d.	0	2	7½
7 ft. 6 ins. run super of 1-in. boarding for pot-board at 4½d.	0	2	9¾
5 ft. run of 6″ × 1″ skirting, at 2½d.	0	0	11¼
10 ft. run of 2″ × 1½″ bearers, at 1½d.	0	1	0½
2 ft. 3 ins. run of 4″ × 1½″ cross-bearers, at 2½d.	0	0	5
7 ft. 6 ins. super 1¼ teak, at 2s. (including planing)	0	15	0
4 ft. 6 ins. run 9″ × 1″ drawer fronts, at 3½d.	0	1	2½
5 ft. run 9″ × ¾″ drawer sides, at 2d.	0	0	10
4 ft. 6 ins. run 9″ × ¾″ drawer backs, at 2d.	0	0	9
6 ft. 6 ins. super ¾-in. boarding for bottom of drawers at 3½d.	0	1	9
5 ft. run of 4″ × ¾″ skirting, at 1d.	0	0	5
10 ft. run 9″ × 1¼″ side pieces, at 4½d.	0	3	9
5 ft. run 6″ × 1″ shelf, at 2½d.	0	0	11¼
5 ft. run 7″ × 1″ shelf, at 2½d.	0	1	0½
5 ft. run 9″ × 1″ shelf, at 3½d.	0	1	4½
9 ft. run 9″ × 1″, at 3½d.	0	2	5¼
7 ft. 3 ins. moulding, at 3d.	0	1	9¾
15 ft. run, form grooves for plates at ½d.	0	0	7½
Waste on material, 10 per cent. on £2 2s. 9d.	0	4	3¼
Making drawers, joiner, 6 hours, at 1s. 8d.	0	10	0
Framing up dresser, joiner, 4 hours, at 1s. 8d.	0	6	8
Fixing on job, carpenter, 3 hours, at 1s. 8d.	0	5	0
Sundries, 2½ per cent. on £3 8s. 8d.	0	1	8½
Total cost of dresser	£3	10	4½

In the above example ¾-in. boarding has been taken, but if preferred plywood could be used instead.

Pipe Casings.—Take off the quantities of timber for an actual length and allow for carpenter fixing 10 ft. super per hour.

Shelves.—Take off the quantities of timber, and allow carpenter fixing 12 ft. super per hour.

W.C. Seats.—Allow for carpenter fixing, ½ hour, but if double flap allow 1 hour.

W.C. Cistern Back-boards.—Allow for 1 foot super of timber and ½ hour for carpenter for fixing. The chamfered edge is worth ½d. per foot.

(*Note.*—All the prices in the foregoing items are based upon timber at 4s. 6d. per foot cube prepared, with no allowance for profit.)

Hardwoods.—The work in hardwoods is kept entirely separate from other work; each different class of wood has a section of the bill to itself. All measurement is similar to soft wood measurement, but naturally the prices of hardwoods are much higher than deal, and the following table is submitted as a rough guide:—

	Cost in Market per Foot Cube.	Cost of Conversion.	Total Cost per Foot Cube.	Cost per Foot Super, 1 in. Thick.
	s. d.	s. d.	s. d.	s. d.
American whitewood	10 0	3 0	13 0	1 1
Teak . . .	14 0	6 0	20 0	1 8
Austrian oak . .	15 0	4 6	19 6	1 7½
Honduras mahogany .	16 0	5 0	21 0	1 9

Labour on Hardwoods.—The labour working most hardwoods is more expensive than with deal, and as a rough guide the following are submitted:—

American Whitewood.—Cost of labour the same as in deal.

Teak.—Cost of labour three times that in deal.

Oak.—Cost of labour twice the cost of work in deal.

Mahogany.—Cost of labour two and a half times that in deal.

Ironmonger.

This is sometimes kept separate from the joiner's bill, but is more frequently included in the same bill. It is a simple matter to price the items, as the fittings usually have a P.C. amount attached. The only data required are for fixing, and the following typical cases are given, viz.:—

Butts, per pair . .	20 minutes	Cross garnets, per pair	30 minutes.
Flush bolts, each .	20 ,,	Barrel bolts, each .	10 ,,
Cupboard locks, each .	½ hour.	Rim locks, each .	1 hour.
Mortice locks and furniture, per set . .	3 hours.	Casement stay and pin	¼ ,,
Sash fasteners, each .	¼ hour.	Letter plate and forming hole . . .	1 ,,
Cockspur fasteners, each . .	¼ ,,		

The fixing of other ironmongery can be priced at proportionate rates. With regard to the prices of ironmongery and brasswork, the various manufacturers publish small pocket-books giving nett prices, therefore it is considered unnecessary to reproduce them here.

CHAPTER XII.

STRUCTURAL ENGINEER; STEEL AND IRONWORKER; HOT-WATER ENGINEER; AND GASFITTER.

STEEL CONSTRUCTION.

Steel-framed buildings frequently are erected by specialist contractors, who fabricate and fix the steel work complete; therefore this work will not be analysed in detail herein, but builders often have to fix and to estimate for detached steel joists and stanchions appearing in the bill headed "Smith and Founder." This work is billed by weight, and it is not easy to price the items unless the lengths and the heights for hoisting are given. The structural engineers will quote for extra items such as cuts and holes.

It is considered unnecessary to give many examples of steel construction, as the builder will be well advised to obtain quotations for this work from specialists.

Detailed Prices.—As examples, assume two rolled-steel beams each 15 ft. long, bolted together, each being 8″ × 6″; that there are twenty-eight holes for bolts and nuts with distance pieces, and that both ends are built into walls. At right angles to this compound beam and fixed to the web, assume that there is a length of 6″ × 3″ (say 9 ft. 4 ins. in length), and one end is built into a wall. The weight of 8″ × 6″ is 35 lbs., and the weight of 6″ × 3″ is 12 lbs. each per foot run. The following items will therefore occur in the bill:—

Mild Rolled Steel in Compound Beams, *between* 15 *ft. and* 20 *ft. long, including hoisting and fixing* 15 *ft. above ground level.*

18 cwts. 3 qrs. B.S.B., at 13s. 6d. per cwt., delivered	£12	13	1½
Hoisting, 2 labourers, 5 hours, at 2s. 6½d.	0	12	8½
Bricklayer and labourer, bedding, 1 hour, at 2s. 11½d.	0	2	11½
	£13	8	9½

Dividing by the total weight gives the price per cwt. of 14s. 4d. There will be twenty-eight holes for bolts and nuts, for which the makers charge about 3d. each. There will be fourteen bolts and nuts about 9d. each, and the engineer's time must be allowed for; he should fix eight to twelve per hour. The angle plates should be given separately, and to work out the cost allow 40 lbs. per foot super for the metal "as inch." The merchants will quote for these already drilled about 5s. each, but the engineer's time fixing on the job must be allowed for, and this will take about 1 hour each. The distance pieces will be supplied about 6d. each, but there will be no charge for fixing, as this cost will be included in the charge for fixing bolts and nuts. In fixing the second joist, although it is not so heavy, time will be spent by a labourer attending upon the engineer whilst the joist is being connected to the compound girder.

Mild Steel in Beams, *including hoisting and fixing* 15 *ft. above ground level.*—

1 cwt. rolled steel in beam (as before) . . .	£0	13	6
2 labourers, hoisting, etc., 3 hours, at 2s. 6½d. .	0	7	7½
Bricklayer and labourer, bedding one end, ½ hour, at 2s. 11½d.	0	0	8½
	£1	1	10½

The cost of this last item is £1 1s. 10½d. per cwt. as against the cost of the previous item of 14s. 4d. per cwt., so it will be seen that the smallest beams or joists are not necessarily the least expensive. One end of this beam would be "cut to dead length," and for this the merchant's usual charge is 1s. 6d. Other items of constructional steelwork can be worked out in a similar manner. The holes, bolts and nuts, angle plates, and cuts are billed separately in a bill of quantities, and are therefore priced accordingly.

Mild Steel in Solid Column, 15 ft. in height, fitted with cap and base, 14″ × 14″ × 2½″, shrunk on machined ends, including fixing at ground level.

Assume that the column is 7 ins. in diameter.

17 cwts. 2 qrs. mild steel in column, at 20s. per cwt.	£17	10	0
2 caps, each 136 lbs., i.e. 2 cwts. 2 qrs. 2 lbs., at 20s.	2	10	2
Delivery to job (say), 1 ton, at 7s. . . .	0	7	0
Fixing, 4 labourers, 4 hours, at 5s. 1d. . . .	1	0	4
	£21	7	6

The total weight of the above being exactly 1 ton, dividing by 20 gives the price of £1 1s. 5d. per cwt.

Steel Gutters and Rain-water Pipes (ordinary sections).—These can be obtained in sizes and patterns similar to cast-iron rain-water goods, and the cost works out at about 15 per cent. less for the material. The cost of fixing is the same as for cast-iron rain-water goods (see later).

Steel Trough Gutters.—These can be obtained in many sizes, and are used for large factory and similar roofs. They are billed by weight. For gutters from 6 ins. to 9 ins. wide in the sole a fair allowance for fixing would be 1½ hours fitter and mate per 6 ft. length. The wrought-iron straps or stays for fixing should be enumerated and the weights given, and the prices would be similar to the other prices given under the heading "Wrought Iron."

Work Executed "In Position."—In fixing steelwork generally it is sometimes necessary for certain items to be executed "in position," especially in repair work or alterations, and this work is naturally somewhat expensive. As a rough guide the following are submitted :—

Ordinary holes in webs	.	.	1¼ hours, fitter and mate
,, ,, flanges	.	.	1½ ,, ,,
Cutting ends up to 7″ × 4″	.	.	2 ,, ,,
,, ,, 12″ × 6″	.	.	3½ ,, ,,
,, ,, 20″ × 7½″	.	.	6½ ,, ,,

Wrought Ironwork.

Wrought Iron.—This is no longer a constructional metal, owing to the use of mild steel, but for detached details such as railings, chimney-bars, straps, stays, guard-bars, and similar articles, it is still extensively used.

Most items are billed by weight in a Bill of Quantities, and it is not easy to price wrought-iron manufactured articles by this unit. As explained for other trades, data must be found from an average of many costs, but as a general rule it will be found that the time spent by the smith in making wrought-iron articles will work out from 10 hours to 15 hours per cwt. The cost depends upon the pattern of the article, but the following will give sufficient data for most items, viz. :—

Plain chimney-bars, each 1 hour ; *if cambered and caulked*, 2 hours. *Plain straps*, drilled complete, 2 hours ; ditto, if three-way, each 4 hours. *Purpose-made gutter brackets*, each ½ hour. *Hip hooks*, each 1 hour. *Plain iron rails*, each 1 hour. *Ornamental rails*, each 2 to 3 hours.

The metal for typical examples can be worked out and a price per pound obtained. One foot super of wrought iron, 1 in. thick, weighs approximately 40 lbs.; other thicknesses can be calculated by proportionate methods, i.e. ½-in. iron per foot super would be 20 lbs., and so on.

Corrugated Iron Sheeting.

This material can be obtained in sheets varying in size from 5 ft. to 10 ft. in length; and in several gauges, from No. 26 to No. 18. The material is sold by weight, and is priced in a Bill of Quantities per square super. For the purpose of preparing a typical cost, assume a space of roofing 15 ft. in length (of slope), and 10 ft. in width, i.e. 150 ft. super. Two sheets, 8 ft. in length, will cover the 15 ft. slope, allowing for a lap of 12 ins., and as one sheet covers 2 ft. in width (allowing a lap of one corrugation), the 10 ft. in width will require five sheets, therefore the whole space will require ten sheets. One sheet 8 ft. in length of No. 22 gauge weighs 27½ lbs., therefore the total weight of the corrugated iron required for the typical roof space is 2 cwts. 1 qr. 23 lbs.

Detailed Cost: Galvanised Corrugated Iron Roofing, No. 22 gauge, in 8 ft. lengths, laid with a vertical lap of 12 ins. and a horizontal lap of one corrugation, fixed with galvanised bolts and nuts, and galvanised hook bolts and curved washers.

2 cwts. 1 qr. 23 lbs. galvanised corrugated iron, at 18s.	£2	4	4
4 doz. ¾" × ¾" galvanised bolts, nuts, and washers, at 3s. per gross			
4 doz. galvanised hook-bolts and nuts, at 6s. 6d per gross			
4 doz. curved washers, at 3s. 3d. per gross			
Smith and labourer, fixing 10 sheets at ½ hour per sheet, 2½ hours, at 2s. 11½d.	0	7	4
Total cost	£2	15	11

The above total represents 150 ft., which works out at £1 17s. 2d. per square.

The above is but one of the many methods of using this material, but it will serve for a typical example; the sizes of the sheets, the gauges, and the weights can be found in the manufacturers' catalogues, but quotations should always be obtained, as the prices fluctuate considerably. In the example it is assumed that no waste occurs; usually 10 per cent. should be allowed.

Corrugated Asbestos Sheeting.

This material is sold by the yard super, and billed by the square. Light sheeting costs about 1s. 10d. per yard super and heavy sheeting about 2s. 1d. per yard super. The actual width of the sheet is usually 2 ft. 6 ins., but when laid the cover is 2 ft. 1½ ins.; usually the horizontal lap is 6 ins.

The fixing is similar to corrugated iron and the time taken also the bolts and washers will be the same as given for corrugated iron.

About 14 sq. yds. are required per square, but a percentage of 10 per cent. should be added for waste.

Hot-water Engineer.

(*Including the fixing of wrought-iron pipes generally.*)

This trade is passing into the hands of specialists, and has become an engineering trade, especially as regards the warming of buildings by hot-water apparatus, but the builder is frequently called upon to instal the hot-water pipes to baths, lavatory basins, sinks, and other fitments, and frequently the whole bill is provisional and the work measured at completion. One of the most difficult items to value is the cutting away and the making good in other trades; this again should be provisional, as it is impossible to price the item without measurements.

Barrel or Tubes.—The barrel (or pipe) and fittings are all priced in the Standard List, a copy of which is given herein, and this Standard List is subject to a large discount, which varies from time to time, and is at present 57½ per cent. off for steam pipe, and about 42½ per cent. off for galvanised steam pipe.

Galvanised pipe should be used for domestic supplies, to prevent discoloration of the water and rusting of pipes, therefore in the typical example which follows galvanised pipe has been assumed.

The Bill of Quantities should give the length of piping required and the number of the fittings, but it should be remembered that when fixing pipes many more fittings are necessary than would be expected from an examination of small-scale drawings. Walls which set back slightly from floor to floor,

Nominal Internal Diameter in Inches.	⅛ & ¼.	⅜.	½.	¾.	1.	1¼.	1½.	1¾.	2.	2½.	2¾.	3.	3½.	4.	4½.	5.	6.
TUBES.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Tubes, 2 ft. long and over, per ft.	0 4	0 4½	0 5½	0 6½	0 9½	1 1	1 4½	1 8	1 10	2 6	2 10	3 3	4 0	4 5	5 6	6 0	7 6
Pieces, 12″ to 23½″ long . each	0 10	0 11	1 1	1 5	1 11	2 8	3 4	4 6	4 9	6 9	8 0	10 6	13 6	15 6	21 0	24 0	32 6
4″ to 11½″ ,, . . ,,	0 7	0 8	0 9	0 11	1 3	1 8	2 2	2 10	3 0	4 3	5 3	6 9	9 3	10 9	15 6	18 0	25 3
Long screws, 12″ to 23½″ long . ,,	0 11	1 0	1 3	1 7	2 2	2 10	3 9	5 0	5 3	7 6	9 0	12 0	15 6	17 0	23 0	26 6	35 6
3″ to 11½″ ,, . . ,,	0 8	0 9	0 10	1 1	1 5	1 11	2 6	3 3	3 6	5 0	6 6	8 6	11 6	13 0	17 0	20 0	28 0
Barrel nipples . . ,,	0 5	0 5	0 6	0 7	0 9	1 0	1 4	1 8	1 9	2 6	3 0	4 0	6 0	7 0	10 0	12 6	20 0
Bends . . . . ,,	0 8	0 9	0 11	1 2	1 7½	2 7½	3 2	4 2	5 2	8 6	12 0	18 0	25 0	32 6	80 0	105 0	150 0
Springs, not socketed ,,	0 5	0 6	0 7	0 9	1 1½	1 11½	2 3½	3 1	3 11	6 9	9 6	14 6	20 0	26 6	70 0	93 0	132 0
FITTINGS.																	
Socket or pipe union each	2 0	2 6	3 0	4 0	5 6	6 9	8 0	9 0	10 0	15 0	17 6	22 6	27 6	35 0	48 0	66 0	105 0
Elbows, square . ,,	0 10	0 11	1 1	1 3	1 6	2 2	2 7	3 4	4 3	6 9	9 6	14 0	22 0	28 0	75 0	95 0	150 0
,, round . ,,	0 11	1 0	1 2	1 5	1 8	2 4	2 10	3 9	4 8	7 3	10 6	16 0	24 0	30 0	75 0	95 0	150 0
Tees . . . . ,,	1 0	1 1	1 3	1 7	1 10	2 6	3 1	4 2	5 1	7 9	11 6	18 0	26 0	32 0	78 0	98 0	155 0
Crosses . . . . ,,	2 2	2 4	2 9	3 3	4 1	5 6	6 7	8 6	10 6	17 0	22 0	40 0	56 0	68 8	175 0	220 0	350 0
Sockets, plain . ,,	0 3	0 3	0 4	0 5	0 6	0 8	0 10½	1 1	1 3	1 9	2 6	3 6	5 0	6 0	10 0	12 0	18 0
,, diminished ,,	0 4	0 5	0 6	0 7	0 9	1 0	1 4	1 9	2 0	4 0	5 0	7 0	9 0	11 0	25 0	35 0	55 0
Flanges. . . . ,,	0 9	0 10	1 0	1 2	1 4	1 9	2 0	2 3	2 9	4 0	5 0	8 6	10 0	11 6	16 0	18 0	27 0
Caps . . . . ,,	0 3½	0 3½	0 5	0 6	0 8	1 0	1 3	1 7	2 0	3 0	4 4	6 0	9 9	10 6	25 0	30 0	45 0
Plugs . . . . ,,	0 3	0 3	0 4	0 5	0 6	0 8	0 10	1 0	1 3	2 0	2 6	4 9	7 0	10 0	22 0	30 0	48 0
Backnuts . . . ,,	0 2	0 2	0 3	0 3½	0 5	0 6	0 8	0 10	1 1	1 9	2 3	3 6	4 6	5 6	14 0	18 0	26 0
Nipples . . . ,,	0 2	0 2	0 3	0 3½	0 4	0 6	0 8	0 10	1 0	1 9	2 3	3 6	4 6	5 6	14 0	18 0	26 0
Union bends . . ,,	2 6	3 0	3 9	5 0	6 3	8 6	10 0	11 6	13 6	21 0	27 0	37 0	49 0	58 0	78 0	100 0	160 0
Main cocks . . ,,	1 6	1 9	2 3	2 10	4 2	5 4	7 0	11 6	11 6	16 0	17 6	26 0	40 0	47 9	125 0	125 0	165 0
,, with brass plugs ,,	—	3 4	4 0	5 4	7 6	10 0	13 0	21 0	21 0	34 0	40 0	50 0	75 0	100 0	225 0	225 0	325 0
Round way cocks . ,,	—	2 7½	3 0	4 1½	5 7½	7 6	9 9	13 1½	16 6	28 6	45 0	56 3	90 0	120 0	—	—	—
,, with brass plugs ,,	—	7 10½	9 0	12 4½	16 10½	22 6	29 3	39 4½	49 6	85 6	135 0	168 9	270 0	360 0	—	—	—
Cock spanners, wrought . . ,,	—	1 1½	1 3	1 7½	2 0	2 4½	2 7½	3 0	3 3	3 7	4 6	6 9	9 0	10 6	12 0	14 3	18 0
malleable cast . ,,	—	0 9	1 0	1 3	1 6	1 9	2 3	2 7½	3 0	3 7	4 6	6 9	9 0	10 6	12 0	14 3	18 0

joists and beams which have to be avoided, and similar circumstances, may necessitate the provision of extra fittings, and allowance should be made accordingly. Tubes can be obtained in lengths of 12 ft., and economy can be effected by using as long lengths as possible, so as to avoid many joints. Pipes 1½ ins. in diameter and under must include for all short-running lengths, sockets, bends, and all other fittings (except tees and diminishing pieces), so these must be allowed for in the price per foot run.

Waste.—For waste in cutting about 5 per cent. should be sufficient, as many short lengths can be used elsewhere.

Discounts Off Standard Lists.—At the time of going to press the following discounts were current. It will be noticed that the discount for pipe fittings is at a different rate to the pipe :—

Description of Pipe.	Tubes. ⅛ in. to 6 ins.	Fittings.
Black gas . . .	65 per cent.	57½ per cent.
Blue water . . .	61½ ,,	52½ ,,
Steam . . .	57½ ,,	47½ ,,
Galvanised steam . .	42½ ,,	37½ ,,

Labour, Pipe Fitting.—The following are submitted for fitter and mate per 12 ft. length in hours, for pipes of different diameters :—

½-in. Dia.	¾-in. Dia.	1-in. Dia.	1¼-in. Dia.	1½-in. Dia.	2-in. Dia.
1½ hrs.	2 hrs.	2 hrs.	3 hrs.	3 hrs.	3½ hrs.

For *bends, elbows, tees,* etc., the prices can be obtained from the Standard List, and the following table gives the time for fitter and mate in minutes :—

½-in. Dia.	¾-in. Dia.	1-in. Dia.	1¼-in. Dia.	1½-in. Dia.	2-in. Dia.
10 mins.	10 mins.	12 mins.	15 mins.	20 mins.	25 mins.

For *hemp, red and white lead* add 2½ per cent. to cost of material only.

If *bends* have to be *specially made*, as is necessary in some special positions, then the following will be necessary in hours :—

½-in. Dia.	¾-in. Dia.	1-in. Dia.	1¼-in. Dia.	1½-in. Dia.	2-in. Dia.
½ hour.	½ hour.	¾ hour.	1 hour.	1 hour.	1¼ hour.

Drilling and Tapping Boiler.—Fitter and mate, 4 hours.
Ditto, Ordinary Cylinder.—Fitter and mate, 6 hours.
Ditto, Ordinary Tank.—Fitter and mate, 4½ hours.
Detailed Cost :—

1¼-in. Galvanised Wrought-iron Steam Barrel, *fixed complete, including all short running lengths, sockets, connections, elbows, and bends.*—For the purpose of calculating the price per foot run, a typical case requiring 200 ft. run of barrel is assumed, such as might be required for ordinary flow and return pipes.

200 ft. run of 1¼-in. barrel, as tube list, at 1s. 1d.				£10	16	8
6 short pieces, at 2s. 8d.				0	16	0
				£11	12	8
Less discount for galvanised pipe, 42½ per cent.				4	18	6
				£6	14	2
Add for waste in cutting, 5 per cent.				0	6	10
6/1¼-in. connectors and back nuts, at 3s. 4½d.	£1	0	3			
18/1¼-in. elbows, at 2s. 4d.	2	2	0			
6/1¼-in. sockets, at 8d.	0	4	0			
	£3	6	3			
Less discount, 37½ per cent.	1	0	10			
				2	5	5
Fitter and mate, fixing pipes, 17 hours; ditto, fixing fittings, 7½ hours—total, 24½ hours, at 2s. 11½d.				3	11	11½
40 pipe clips, at 2d. each				0	6	8
Red lead and hemp, 2½ per cent. on £9 7s. 5d.				0	4	11
Total cost				£13	9	11½

Dividing the above by 200 gives the price per foot run of 1s. 4¼d.

Branch pipes and pipes of different diameters can be worked out in a similar manner.

Copper Tube.

Copper is now fairly cheap, and is used extensively for hot and cold water. It is detailed herein in "Plumber."

Gasfitter.

The work in this trade is measured and priced in exactly the same way as for "Hot-water Fitter." To the various data given for fitter the following adjustments can be made. For small-bore pipes, deduct 15 per cent. from the time, and for pipes, such as 1¼ ins. and over, deduct 10 per cent. from the time given in "Fitter." The price of the barrel as given in the Standard List is subject to a different discount (as given earlier); there is also a different discount for the fittings.

Connect up to Meter.—This is frequently given as a numbered item, and as a general rule about 3 ft. run of 1½-in. compo. pipe is required and a brass union; about 1 hour for fitter and mate should be allowed.

Fixing Fittings.—For gas brackets allow ¼ hour each, and for pendants allow ½ hour each.

CHAPTER XIII.

PLUMBER; SANITARY ENGINEER; ZINCWORKER, AND COPPERSMITH.

PLUMBER.

THE work in this trade can be divided very suitably into three portions, viz. Lead-laying, Pipe Work, and Sanitary Engineering. The Estimating Surveyor often finds difficulty with this trade, especially when no plans are available. The material used fluctuates in price considerably, and the time taken by plumbers over similar tasks, but upon different jobs, will also vary to a remarkable extent. In the fixing of sanitary fittings a great amount of time is often lost in "offering up," i.e. placing the fitments in position temporarily, so as to find what bends and joints are necessary. Some articles have to be placed in position several times before a decision can be made, and after they are fixed it may be necessary to disconnect and remove them temporarily for access for other trades, particularly the plasterer and painter. This second labour of fixing will not take as long as the first occasion, but it is a factor which will affect the price. The jointing of iron drain pipes is described and detailed in "Drainlayer."

Jointing Lead to Iron, or Lead to Stoneware.—It must be remembered in pricing these items that brass thimbles, or brass ferrules, are required, and these cost from 9d. to 3s. 6d. each. Allow for labour jointing for 4-in. pipes, plumber and mate, 1½ hours per joint; for 2-in. pipes, ½ hour per joint. Thimbles are required to joint fireclay or stoneware to lead, and ferrules for jointing lead to iron.

LEAD-LAYING.

Lead being expensive, great care must be taken with the measurements. It is specified by its weight per foot super, and the following are the usual weights, viz.: For flats, 7 lbs.

and 6 lbs.; for flashings and similar work, 6 lbs. and 5 lbs.; and for soakers, 4 lbs. and 3 lbs. Unscrupulous individuals may substitute a lighter weight than that specified, and as many architects are not aware of this, sometimes respectable firms are placed at a disadvantage when tendering. This also applies to lead pipe work, and the prices of a builder who is willing to take the risk of substituting lighter weights than the regulation weights, will be very much lower than the prices submitted by firms of repute. In London and large towns the Water Board Inspectors check the weights of all new pipes installed, so it is not possible for light lead pipe to be substituted.

Lead and Labour in Flats.—As a typical example, assume a flat 30 ft. long and 12 ft. wide, with one centre roll, and eleven cross rolls. To the 30 ft. length the following additions must be made, viz. 11 rolls at 9 ins. each (8 ft. 3 ins.) and two " turn-ups " at 6 ins. each (1 ft.). This gives a total length of 39 ft. 3 ins. To the 12 ft. width add for one roll at 9 ins., and for two nosings into gutter of 4 ins. each; this gives a total width of 13 ft. 5 ins. If these dimensions are " squared," the area of the lead will be found to amount to 526 ft. 7 ins. super (i.e. $526\frac{7}{12}$ ft. super), which, multiplied by 7 lbs., produces a total weight of 32 cwts. 2 qrs. 18 lbs. For the purpose of this example, assume that the lead is laid in twenty-four bays.

Detailed Cost.—

Sheet lead, at £1 4s. per cwt.—32 cwts. 3 qrs. 18 lbs.	£39	9	10
Waste in cutting, 2½ per cent.	0	19	9
Laying 24 bays, at 5 hours per bay, equals—plumber and mate, 120 hours, at 2s. 11½d.	17	12	6
Dressing rolls, 162 ft. run, at 20 ft. per hour—plumber and mate, $8\frac{1}{10}$ hours, at 2s. 11½d.	1	3	9½
Total cost	£59	5	10½

Dividing the above total by the weight of the lead gives the price per cwt. of £1 16s.

Bossed Ends to Rolls and Intersections.—Allow for plumber and mate, ½ hour for each end, or intersection.

Soldered Angles.—Allow for plumber and mate, ¼ hour, and 1 lb. solder at 1s.

Lead and Labour in Gutters.—For a typical example assume two parallel gutters for the flat detailed in the last example, each 30 ft. in length, and 1 ft. wide at the sole. To

the 30 ft. length add the following allowances, viz. : Two drips of 6 ins. each, one roll (in centre) of 9 ins., and two " turn-ups " of 6 ins. each ; this gives a total length of 64 ft. 6 ins. for both gutters. To the width of 1 ft. add for two " turn-ups " of 6 ins. each, and this gives a total of 2 ft. " Squaring " the dimensions gives 129 ft. super, and multiplying by 6 lbs. the final weight of 6 cwts. 3 qrs. 18 lbs. is found.

Detailed Cost.—

6 cwts. 3 qrs. 18 lbs. sheet lead, at £1 4s. . .	£8	5	11
Waste, 2½ per cent.	0	4	2
Plumber and mate, 60 ft. at ½ hour per foot = 30 hours, at 2s. 11¼d.	3	19	9½
Total	£12	9	10½

Dividing by the weight gives the price per cwt. of £1 16s. 4d.

Cesspool Outlet is " Extra only," therefore measure up the extra lead and allow for plumber and mate, 2 hours, and 3 lbs. solder at 1s.

Lead and Labour in Flashings.—For an example, assume 100 ft. run of flashings. If lead tacks are required, allow ½ in. per foot run to the length for the extra lead. Multiplying 108 ft. 10 ins. by 7 ins., and by 5 lbs., gives a total weight of 2 cwts. 3 qrs. 9 lbs.

Detailed Cost.—

2 cwts. 3 qrs. 9 lbs. sheet lead, at £1 4s. . .	£3	8	4
Waste in cutting, 2½ per cent.	0	1	8½
Fixing, at 7½ minutes per foot, equals—plumber and mate, 12½ hours, at 2s. 11¼d. . . .	1	16	
Total	£5	6	3½

Dividing by the weight gives the price per cwt., £1 17s. 5d.

In this last item " passings " have been assumed as 4 ins. every 7 ft. in length, i.e. 4 ft. 8 ins. plus 4 ft. 2 ins. for tacks.

Stepped Flashings.—Allow 12½ minutes per foot run.

Lead Wedging.—Allow 1 lb. lead per 10 ft. and ¼ hour for labour.

Lead Soakers can be worked out in detail, but will be found to cost about 25 per cent. less than flashings.

Lead Trays.—Allow 3½ hours per cwt. for plumber and mate.

Lead-lined Cisterns.—Allow 7 hours per cwt. for plumber and mate.

Solder.—For work requiring solder, it will be found that for every cwt. of lead used, about 2 lbs. of solder will be required, and the present price is 1s. per lb.

Pipe Work.

Lead Water Pipes are priced per foot run, and the price has to include all labour and clips and usually all running joints. Formerly lead pipe was specified as "strong," "medium," or "light," but these terms are out of date; the correct method is to specify the weight per foot (or per yard) run. In London the Metropolitan Water Board requires all pipes conveying water to be of specific weights, and the regulations cover *all* pipes including waste pipes and warning pipes. New By-Laws were made in 1934 under the Act of Parliament of 1932, and for the convenience of students the following extracts are given, viz. :—

Weights in Lbs. per Lineal Yard (Lead Pipes).

	Bore of Pipe in inches.								
	⅜	½	¾	1	1¼	1½	2	2½	3
Service pipes not exceeding 250 ft head of water	5	7	11	16	21	27	38	59	85
Ditto, exceeding 250 ft. and not exceeding 400 ft. head of water.	6	9	15	21	28	35	48	—	—
Distributing pipes for cold water	4	5	8	11	14	18	24	38	54
Ditto for hot water	4½	6	9	12½	16	20	28	44	63
Flushing and warning pipes	2	3	5	7	9	12	16	—	—

Where pipes are to be above ground and within a building ternary alloy lead pipes may be used. Ternary alloy pipes consist of lead with an alloy of antimony or tin, and cadmium, and the Metropolitan Water Board regulations are as in table on next page.

The regulations regarding pipes vary in every district and enquiries must be made locally.

If the Bill of Quantities has been prepared in accordance with the Standard Method of Measurement, it will be found that the cost of the bends for all lead pipes under 1½ ins. in diameter must be included in the price per foot run, but for pipes 1½ ins.

WEIGHTS IN LBS. PER LINEAL YARD (TERNARY ALLOY PIPES).

	Bore of Pipe in inches.								
	⅜	½	¾	1	1¼	1½	2	2½	3
Service pipes not exceeding 250 ft. head of water	3½	5	7½	11	14	18	25½	40	57
Ditto, exceeding 250 ft. and not exceeding 400 ft. head of water	4	6	10	14	19	23½	32	—	—
Distributing pipes for cold water and for hot water	3	4	6	8½	11	13½	19	29½	42
Flushing and warning pipes	All as for lead pipes.								

in diameter and over the bends will be numbered and priced separately. All branch joints and all diminishing joints are enumerated, but the cost of all running joints must be included in the price of the pipe per foot run. Pipes 4 ft. in length and under are known as "short lengths" and are given separately.

Cast-iron Service and Distributing Pipes.—The Metropolitan Water Board regulations states that such pipes must comply with the British Standard Specification for water pipes for a pressure equal to double the pressure to which the pipe will be subjected in use, but no service pipe shall be of a lower standard than Class "C," Table I. of such specification. The cost of jointing and fixing can be calculated as detailed later for iron waste pipes.

Wrought-iron or Steel Pipes.—The Metropolitan Water Board requirement is for all pipes to be of "steam" strength to the following table :—

Bore of Pipe in Inches.	Thickness of Pipe.
½	No. 10 I.S.W.G.
¾	9
1	8
1¼	7
1½	6
2	6
2½	5
3	5

The costs can be ascertained as described elsewhere for hot-water work.

½-in. Diameter Lead Pipe (6 lbs. per Yard) and Fixing.—Assume for an example a length of 112 ft., and allow one running joint every 20 ft. and ½ lb. solder per joint. (It will be noticed that 6 lbs. per yard is for hot-water distributing pipe.)

Detailed Cost.—

	£	s.	d.
2 cwts. lead pipe, at £1 5s.	2	10	0
Waste in cuttings, 2½ per cent.	0	1	6
Joints, say 6 at ½ hour for plumber and mate = 2 hours, at 2s. 11½d.	0	5	10½
3 lbs. solder, at 1s.	0	3	0
Fixing, at 13 ft. per hour, equals—plumber and mate, 8¾ hours, at 2s. 11½d.	1	5	8½
Total	£4	6	1

Dividing the above by 112 gives the price per foot run of 9¼d.

¾-in. Pipe.—Allow for fixing, plumber and mate, 12 ft per hour.

1-in. Pipe.—Allow for fixing, plumber and mate, 10 ft. per hour.

¾-in. Joints.—Allow ⅓ hour, plumber and mate, and ¾ lb. solder.

1-in. Joints.—Allow ½ hour, plumber and mate, and 1 lb. solder.

Bends in ½-in and ¾-in. Pipe.—No allowance is necessary.

1-in. Pipes.—¼ hour per bend is recommended.

Branch Joints, when billed separately, are worked out as above. Other pipes are described later.

Pipe Clips.—These will be required if the pipes are to be fixed to walls when 5 per cent. should be added to cost of pipe.

Cast-iron Work.

In building work, this consists principally of gutters, rain-water pipes, drain pipes, also soil and waste pipes.

Iron drain pipe is described in "Drainlayer," Chapter IV., and iron soil and waste pipes are described later.

Rain-water Goods.

It must be kept in mind that most rain-water goods are sold in 6 ft. lengths, and that usually some portions will require

cutting. The material is sold by the yard run, so care must be taken in pricing quantities to find the price per foot; this is frequently the cause of mistakes made by beginners.

Detailed Cost.—3-in. Cast-iron Rain-water Pipe and Fixing.—For a typical example assume the pipe is for a building 40 ft. in height.

	£	s.	d.
7/6-ft. lengths of pipe, 14 yds., at 2s. 3d. per yd. .	1	11	6
14 pipe nails, at ½d.	0	0	7
Cutting 1 length, plumber and mate, ½ hour, at 2s. 11½d.	0	1	5½
Fixing, plumber and mate, 4 hours, at 2s. 11½d. .	0	11	9
Total cost .	2	5	3½

Dividing by 40 gives the price per foot run of, say, 1s. 1½d. If red lead is specified for joints, allow ¼ lb. per joint (present price 4½d. per lb.): jointing in red lead is not good practice so it is not included in the above analysis.

The numbered fittings, such as *shoes*, *swan-necks*, etc., are "Extra only," so that there is only the extra cost of the fitment to add as the previous price per foot run includes the fixing of all ordinary fittings. The same remark also applies to *hopper heads*.

Rectangular R.W. Pipes.—Add 2 hours (plumber and mate) for seven lengths, and ¼ lb. of lead for each joint if specified, one of which occurs every 6 ft.

Detailed Cost.—4" × 3" Rectangular Cast-iron Rain-water Pipe and Fixing.—Assume a similar building as detailed in the last item.

	£	s.	d.
7/6-ft. lengths of 4-in. pipe = 14 yds., at 5s. 1d. .	3	11	2
8 holderbats, at 1s. 3d. each	0	10	0
16 pipe nails, at ½d. each	0	0	8
Cutting 1 length, plumber and mate, ½ hour, at 2s. 11½d.	0	2	2¼
Fixing, plumber and mate, 6 hours, at 2s. 11½d. .	0	17	7¾
	£5		7¾

Dividing the above total by 40 gives the price per foot run of 2s. 6¾d.

Detailed Cost.—4-in. Cast-iron O.G. Gutter and Fixing to Fascia.—Assume for a typical case 100 ft. run round a building with, say, six angles and three outlets. Allowance must be made for gutter wasted in cutting.

	£	s.	d.
20/6-ft. lengths of gutter, 40 yds., at 1s. 5½d.	£2	17	6
Cutting 4 lengths, plumber and mate, 1 hour, at 2s. 11½d.	0	2	11½
4 doz. 1-in. galvanised mushroom head screws, at 4½d. per doz.	0	1	6
2 doz. gutter bolts and nuts, at 2d. per doz.	0	0	4
5 lbs. red and white lead, at 4½d.	0	1	10½
Fixing, plumber and mate, 20 hours, at 2s. 11½d.	2	18	9
	£6	2	10½

Dividing by 100 gives the price per foot run of 1s. 2¾d.

Detailed Cost.—4-in. Cast-iron Half-round Eaves Gutter and Fixing, including Brackets.—Take as a typical case a building similar to that mentioned in last item, i.e. 100 ft. run nett as fixed.

	£	s.	d.
20/6-ft. lengths, 40 yds., at 1s. 3d.	£2	10	
Cutting 4 lengths, plumber and mate, 1 hour, at 2s. 11½d.	0	2	11½
40 brackets, at 3½d. each	0	11	8
7 doz. screws, at 2d. per doz.	0	1	2
2 doz. gutter bolts and nuts, at 2d. per doz.			4
3½ lbs. red and white lead, at 4½d.			4
Fixing, plumber and mate, 15 hours, at 2s. 11½d.			0¾
Total cost	£5	11	6

Dividing by 100 gives the price per foot run of 1s. 1½d.

From the above it will be seen that for ordinary jobs the time taken for O.G. gutter is one length per hour, and for half-round gutter, one length in ⅔ hour.

Detailed Cost.—5″ × 4″ Cast-iron Moulded Gutter and Fixing Complete.—Assume a typical case of 100 ft. run as before.

	£	s.	d.
20/6-ft. lengths of moulded gutter, 40 yds., at 3s. 3½d.	£6	11	8
Cutting 4 lengths, plumber and mate, 2 hours, at 2s. 11½d.	0	5	10½
4 doz. screws, 4d. per doz.	0	1	4
2 doz. gutter bolts, at 2d. per doz.	0	0	4
7 lbs. red and white lead, at 4½d.	0	2	7½
Fixing, plumber and mate, 30 hours, at 2s. 11½d.	4	8	1½
	£11	9	11½

Dividing by 100 gives the price per foot run of 2s. 3½d.

If *brackets* are used, add for these as shown in the example for half-round gutter.

Angles, nozzles, or outlets are all " Extra only," and there need be no extra charge for fixing.

Sanitary Engineering.

Under this heading it is proposed to include the provision and the fixing of lead and iron soil pipes, waste pipes, and the fixing of sanitary apparatus. For the fixing of sanitary goods only approximate data can be given, as these tasks depend entirely upon the nature of the fittings and their quality. When fixing sinks, baths, and lavatory basins, it must be remembered that traps are necessary; these should be billed separately.

Traps and Joints.—Prices of traps (approximate), 1¼-in., 1s. 9d.; 1½-in., 2s. 6d.; 2-in., 3s. 8d. each. Each trap will necessitate at least one joint, and frequently two, and the following data are suggested for plumber and mate, viz. :—

1¼-in. joints, 30 minutes; 1½-in. joints, 35 minutes; 2-in. joints, 40 minutes. For each joint solder is required as follows, viz. :—

1¼-in. joints	1¼ lbs.
1½ ,, ,,	2 ,,
2 ,, ,,	2½ ,,

Fixing of Apparatus.—The following approximate periods are suggested for plumber and mate :—

W.C. apparatus	3 to 5 hours
Baths . .	3 ,, 8 ,,
Sinks . .	2 ,, 4 ,,
Lavatory basins	2 ,, 6 ,,

Pipes, joints, and traps are extra to above.

Fixing of Waste Pipes.—The following are suggested for plumber and mate, viz. :—

1¼-in. pipe	9 ft. per hour
1½ ,, ,, ...	8 ,, ,,
2 ,, ,, ...	7 ,, ,,

Detailed Cost.—1¼-in. Lead Waste Pipe (14 lbs. per yard) *and Fixing*, including all bends and joints. For example, assume a length of 15 ft.

	£	s.	d.
15 ft. of 1¼-in. pipe = 70 lbs., at £1 5s. per cwt.	0	15	7½
Waste, 2½ per cent.	0	0	3½
Allow for tacks (if required), 5 per cent. . .	0	0	7
Allow (say) 1 joint, plumber and mate, ½ hour, at 2s. 11½d.			5½
Solder for ditto, 1¼-lb., at 1s.			9
Fixing 15 ft., plumber and mate, 1¾ hours, at 2s. 11½d.	0	5	1½
	£1	4	10

Dividing this by 15 gives the price per foot run of (say) 1s. 8d.

Soil Pipes.—In London the London County Council specifies the weights per foot run as follows :—

	3½ ins.	4 ins.	5 ins.
Lead pipes per 10-ft. lengths	65 lbs.	74 lbs.	92 lbs.
Iron pipes per 6-ft. ,,	48 ,,	54 ,,	69 ,,

Detailed Cost.—4-in. Lead Soil Pipe and Fixing.—For a typical example, assume a soil pipe is fixed which is 40 ft. in height.

	£	s.	d.
40 ft. of pipe = 296 lbs., at £1 10s. per cwt.	3	19	3
Waste, at 2½ per cent.	0	2	0
3 joints, plumber and mate, 3 at 1½ hours = 4½ hours, at 2s. 11½d.	0	13	2½
Solder, 3 at 7 lbs. = 21 lbs., at 1s.	1	1	0
Lamp black, 3/2½ oz. = ½ lb., at 5d.	0	0	2½
16 cast lead tacks and nails, at 6d.	0	8	0
Fixing, plumber and mate, 2 hours per length 8 hours, at 2s. 11½d.	1	3	6
Total	£7	7	2

Dividing this by 40 gives the price per foot run of 3s. 8½d.

Bends on Soil Pipe.—Allow 4 hours each for plumber and mate.

Branches on Soil Pipe.—Allow for the extra joints as specified earlier.

Detailed Price.—4-in. Cast-iron L.C.C. Coated Soil Pipe, with ears cast on, and fixing.—Assume a typical length of 40 ft. as before, for the purpose of calculation.

	£	s.	d.
7 lengths = 14 yds., at 4s. 3d.	£2	19	6
Cutting 1 length, plumber and mate, ½ hour, at 2s. 11½d.			5½
6 joints, plumber and mate, 6 at ½ hour = 3 hours at 2s. 11½d.	0	8	9¾
Lead for caulking, 6 at 2 lbs. = 12 lbs. at 2d.	0	2	0
Gasket, ½ lb., at 5d.	0	0	1¼
14 pipe nails, ⅛ lb., at 5d.	0	0	3
Plumber and mate, 1 hour per length = 7 hours, at 2s. 11½d.			6¾
Total	£4	12	8¼

Dividing by 40 gives the price per foot run of 2s. 4d.

Cast-iron Fittings can be priced from any catalogue, but the cost of the joints must be added.

L.C.C. Waste Pipes (or anti-syphonage pipes) and fixing complete. These can be dealt with as follows: Allow for fixing, plumber and mate, 20 minutes per length, 10 minutes per joint, and ½ lb. lead for caulking.

Detailed Price.—2-in. Cast-iron L.C.C. Waste Pipe or Anti-syphonage Pipe.

7 lengths, equal to 14 yds., at 2s. 10d.	£1	19
Cutting 1 length, plumber and mate, ¼ hour, at 2s. 11½d.	0	8¾
6 joints, plumber and mate, 6 at 10 minutes = 1 hour, at 2s. 11½d.	2	11½
Lead for joints, 6 at ½ lb. = 3 lbs., at 2d.	0	6
Gasket, say (see above)	0	1
14 pipe nails (see above)	0	3
Plumber and mate, 20 minutes per length, 2¾ hours at 2s. 11½d.	7	10
	£2	12 0

Dividing the above total by 40 gives the price per foot run of 1s. 3¾d.

Copper Tube Work.—Owing to its durability, resistance to great pressures, and high conductivity, the use of copper tubing for hot-water work is desirable, but owing to its high cost has not been popular until recent years. At the present time the cost of pipe work in copper compares very favourably with work in lead and in galvanised barrel. Copper tubing is also suitable for cold-water supplies, especially in exposed situations such as public conveniences, and for country house work where the water is extremely soft or unsuitable for lead pipe or iron barrel. The joints require great care, and are usually of brass or gun-metal. The tubing can be obtained in two weights, viz. "heavy," for heating installations and similar work; and "light," for ordinary hot- and cold-water supplies. Much of this work is in the hands of specialist contractors, but for ordinary hot- and cold-water supplies builders will find it advantageous to investigate the question of costs. The pipes themselves can be bent to shape, and this will often save many bends and elbows. It is impossible to give detailed costs, for so much depends upon the "lay-out" of the installation, but the following are submitted (p. 166).

The prices are inclusive of all necessary copper clips, and gun-metal fittings of the "Kontite," "Securex," "Instanter," and similar types, but in actual practice all couplings in the running lengths of pipes under and including those 1¼-in.

Dividing this by 15 gives the price per foot run of (say) 1s. 8d.

Soil Pipes.—In London the London County Council specifies the weights per foot run as follows :—

	3½ ins.	4 ins.	5 ins.
Lead pipes per 10-ft. lengths	65 lbs.	74 lbs.	92 lbs.
Iron pipes per 6-ft. ,,	48 ,,	54 ,,	69 ,,

Detailed Cost.—4-in. Lead Soil Pipe and Fixing.—For a typical example, assume a soil pipe is fixed which is 40 ft. in height.

	£	s.	d.
40 ft. of pipe = 296 lbs., at £1 10s. per cwt. . .	3	19	3
Waste, at 2½ per cent.	0	2	0
3 joints, plumber and mate, 3 at 1½ hours = 4½ hours, at 2s. 11½d.	0	13	2½
Solder, 3 at 7 lbs. = 21 lbs., at 1s.	1	1	0
Lamp black, 3/2½ oz. = ½ lb., at 5d. . . .	0	0	2½
16 cast lead tacks and nails, at 6d. . . .	0	8	0
Fixing, plumber and mate, 2 hours per length = 8 hours, at 2s. 11½d.	1	3	6
Total	£7	7	2

Dividing this by 40 gives the price per foot run of 3s. 8½d.

Bends on Soil Pipe.—Allow 4 hours each for plumber and mate.

Branches on Soil Pipe.—Allow for the extra joints as specified earlier.

Detailed Price.—4-in. Cast-iron L.C.C. Coated Soil Pipe, with ears cast on, and fixing.—Assume a typical length of 40 ft. as before, for the purpose of calculation.

	£	s.	d.
7 lengths = 14 yds., at 4s. 3d.	£2	19	6
Cutting 1 length, plumber and mate, ½ hour, at 2s. 11½d.	0	1	5½
6 joints, plumber and mate, 6 at ½ hour = 3 hours at 2s. 11½d.	0	8	9¾
Lead for caulking, 6 at 2 lbs. = 12 lbs. at 2d.	0	2	0
Gasket, ½ lb., at 5d.	0	0	1¼
14 pipe nails, ⅜ lb., at 5d.	0	0	3
Plumber and mate, 1 hour per length = 7 hours, at 2s. 11½d.	1	0	6¾
Total	£4	12	8¼

Dividing by 40 gives the price per foot run of 2s. 4d.

Cast-iron Fittings can be priced from any catalogue, but the cost of the joints must be added.

L.C.C. Waste Pipes (or anti-syphonage pipes) and fixing complete. These can be dealt with as follows: Allow for fixing, plumber and mate, 20 minutes per length, 10 minutes per joint, and ½ lb. lead for caulking.

Detailed Price.—2-in. Cast-iron L.C.C. Waste Pipe or Anti-syphonage Pipe.

	£	s.	d.
7 lengths, equal to 14 yds., at 2s. 10d.	1	19	8
Cutting 1 length, plumber and mate, ¼ hour, at 2s. 11½d.			
6 joints, plumber and mate, 6 at 10 minutes = 1 hour, at 2s. 11½d.		2	11½
Lead for joints, 6 at ½ lb. = 3 lbs., at 2d.		0	6
Gasket, say (see above)		0	1
14 pipe nails (see above)		0	3
Plumber and mate, 20 minutes per length, 2¾ hours at 2s. 11½d.	0	7	10
	£2	12	0

Dividing the above total by 40 gives the price per foot run of 1s. 3¾d.

Copper Tube Work.—Owing to its durability, resistance to great pressures, and high conductivity, the use of copper tubing for hot-water work is desirable, but owing to its high cost has not been popular until recent years. At the present time the cost of pipe work in copper compares very favourably with work in lead and in galvanised barrel. Copper tubing is also suitable for cold-water supplies, especially in exposed situations such as public conveniences, and for country house work where the water is extremely soft or unsuitable for lead pipe or iron barrel. The joints require great care, and are usually of brass or gun-metal. The tubing can be obtained in two weights, viz. "heavy," for heating installations and similar work; and "light," for ordinary hot- and cold-water supplies. Much of this work is in the hands of specialist contractors, but for ordinary hot- and cold-water supplies builders will find it advantageous to investigate the question of costs. The pipes themselves can be bent to shape, and this will often save many bends and elbows. It is impossible to give detailed costs, for so much depends upon the "lay-out" of the installation, but the following are submitted (p. 166).

The prices are inclusive of all necessary copper clips, and gun-metal fittings of the "Kontite," "Securex," "Instanter," and similar types, but in actual practice all couplings in the running lengths of pipes under and including those 1¼-in.

COPPER TUBING SUPPLIED AND FIXED COMPLETE.

Diameter of Pipe in Inches.	Gauge.	Price per Foot Run fixed complete with all Fittings.
½	No. 18	9½d.
¾	No. 18	11d.
1	No. 17	1s. 3d.
1¼	No. 17	1s. 6d.
1½	No. 17	1s. 10d.
2	No. 16	2s. 4d.
2½	No. 16	2s. 9d.

in diameter would be included in the price of the pipe per foot run. All tees, elbows, reducers, and other fittings and couplings for pipes 1½-in. and over in diameter would be given separately.

The weights of copper tubes are given below.

Size in Inches.	Gauge.	Lbs. per Foot Run.
½	No. 18	0·32
¾	No. 18	0·46
1	No. 17	0·71
1¼	No. 17	0·88
1½	No. 17	0·05
2	No. 16	1·60
2½	No. 16	1·98
3	No. 15	2·68

The following are the current prices of the usual gun-metal fittings :—

	½″	¾″	1″	1¼″	1½″	2″	2½″	3″
Straight couplings	1s. 5d.	1s. 9d.	2s. 7d.	3s. 4d.	4s. 4d.	5s. 11d.	15s. 11d.	25s. 3d.
Ditto, copper to iron	1s. 5d.	1s. 11d.	2s. 7d.	3s. 7d.	4s. 10d.	6s. 6d.	11s. 5d.	19s. 2d.
Ditto, copper to lead	1s. 6d.	1s. 11d.	2s. 11d.	3s. 8d.	5s. 1d.	6s. 6d.	11s. 6d.	19s. 3d.
Tees	2s. 8d.	3s. 1d.	5s.	7s. 3d.	10s. 6d.	14s. 11d.	21s. 11d.	50s. 1d.
Bends	2s.	2s. 5d.	3s. 8d.	4s. 8d.	7s. 6d.	11s. 3d.	16s.	34s. 7d.
Cross-pieces	3s. 9d.	4s. 3d.	6s. 6d.	7s. 11d.	12s. 5d.	17s. 4d.	—	—

The foregoing prices are subject to a variable discount, but if the basic price of copper tube be taken at 10d. per lb., it would be safe to deduct 10 per cent. from the prices. The prices of the fittings will fluctuate at about the same rate as the tube.

The copper fixing clips cost per dozen—

¾"	1"	1¼"	1½"	1¾"	2"
1s. 3d.	1s. 10d.	2s. 5d.	3s. 8d.	4s. 6d.	5s. 5d.

The labour taken by a fitter and mate to fix the pipe including fittings and clips is as follows :—

Diameter of Pipe in Inches.	Time in Hours per Foot Run.
½	⅛
¾	1/7
1	⅕
1¼	¼
1½	⅓
2	3/7
2½	½

A development is now taking place which in the future will reduce the cost of copper tube work considerably. A new type of fitting has been invented and patented known as the "Yorkshire" fitting, and it enables a soldered "sweated" joint to be made. The fitting is supplied with the solder contained therein, and the joint simply requires the use of a blow-lamp for a few moments and capillary attraction completes the job.

ZINCWORKER.

This work is usually sub-let to specialists, therefore it will not be detailed here. The material is sometimes sold by the

sheet (8′ × 3′) or by weight. No. 16 gauge, which is usual for roof work, weighs 1½ lbs. per square foot. The price of zinc varies round about £24 per ton. Allow for laying, zincworker and mate, 10 minutes per foot super; for extra labour on rolls, allow 10 minutes "extra only" per foot run; and for saddles allow 10 minutes each. The zinc in the rolls is either measured in with the roofing or, if given separately, it can easily be calculated, taking the length of roll and multiplying by 8 ins. Specialist contractors can carry out this work from 5d. to 8d. per foot super.

Zinc Gutters will take about the same amount of time to fix as iron ones, detailed in "Plumber," but *zinc rain-water pipes* will take about 20 per cent. less time.

COPPERSMITH.

Copper Roofing.—The price of this material fluctuates, and as the work is usually sub-let to specialists, no detailed costs will be given. With the price of sheet copper at 10d. per lb., the price of copper roofing, including labour and material, would cost from 1s. 1d. to 1s. 4d. per foot super.

CHAPTER XIV.

PLASTERER.

In pricing this bill, several peculiar factors have to be taken into consideration. In the first place, the weather has a considerable effect upon the material, also its rate of setting. If the job, therefore, is to be executed during the winter months, the work will take longer to set, and in consequence the prices must be increased. A difference also occurs between work executed upon the exterior of a building and the interior, as wet weather can be disastrous to external work, whilst damp or foggy atmosphere may seriously damage the internal work. Another factor, often overlooked, is the plant and scaffolding necessary. If the external plastering can be worked from the bricklayer's scaffold, no extra cost will be incurred, as the cost will be included in the prices for brickwork, but if the whole of the external walls of a structure are to be plastered, it is seldom possible for the plasterers to use the bricklayer's scaffold. It is usually too high, and frequently too close to the walls; therefore, it may be necessary to erect a fresh scaffold, the cost of which must be added to the plasterer's items. Internal work will require a scaffold, and the cost of this must be included. Especially does this apply to ceilings, and if the rooms are lofty the scaffolding may prove expensive, but work to walls can be worked from trestles and boards if the rooms are not lofty. The cost of scaffolding is detailed in Chapter II., but cost of transport must be added.

In London and in many other large towns the plasterer's work is frequently sub-let to piece-work contractors, and from the builder's point of view, there is no doubt that this is the most economical procedure; but in comparing prices, or obtaining quotations, the Estimating Surveyor must remember that the building contractor may be required to provide all scaffolding, and the cost must be added to the piece-work price, in addition to any profit and charge for attendance.

In Bills of Quantities it is usual for the work to be divided into two portions, viz. external work and internal work, but for the purpose of this book it is unnecessary to make this distinction, as the proportions of the materials are the same in each case, and adjustments can be made for the extra labour, or the use of plant, as the items occur. Certain materials, such as "plasterer's putty" and "coarse stuff," have to be prepared for a considerable time before use; these are described and analysed in Chapter II.

Methods of Calculation.—For the purpose of pricing the items as they occur in a Bill of Quantities, the cost of the material per yard super, and in some cases per foot super, or per foot run, will be required, and all prices depend upon the thickness of the coat of material. An easy method (first published in this book) is to divide the price of a cubic yard of the material by 3, which gives the price per yard super if 12 ins. thick, then dividing this figure by 12 gives the price per yard super as 1 in. thick. This can be performed mentally by calling the shillings pence, and the parts of shillings parts of pence, (as described in "Carpenter" for working out timber). Other thicknesses less than 1 in., or in multiples of an inch, can be found by proportion. For example, the "coarse stuff" at £1 0s. 3d. per yard cube, as detailed in Chapter II., works out at 10$\frac{1}{12}$d. per yard super when 1 in. thick, and 5$\frac{1}{6}$d. when $\frac{1}{2}$ in. thick. The "fine stuff" at £1 4s. 3$\frac{1}{2}$d. will work out at 8$\frac{1}{12}$d. per yard super, 1 in. thick.

Narrow Widths.—Certain plasterer's items are priced per foot run, such as in "narrow widths," arrises, coves, etc., and these also can be found by proportionate methods. If the price per yard super for the item "Render, float, and set" is 2s. 6d., the price per foot run for 6-in. narrow widths can be found as follows: Dividing 2s. 6d. by 6 gives 5d., which is the price of a length 3 ft. long and 6 ins. wide; so dividing 5d. by 3 gives the price of, say, 2d. per foot run, but to this figure it is usual to add about 50 per cent. for the extra labour. Work not exceeding 12 ins. wide is termed in "narrow widths," and if more than 6 ins. wide is billed per foot super; it is frequently priced by plastering contractors at one-sixth of the price per yard super for ordinary work. Waste is described later.

Scaffolding.—This is described in the chapter on "Brickwork," but it may be necessary to add the cost to this work,

and for external plastering special scaffolding may become necessary, but in the following detailed costs the scaffolding and transport have not been included, as so much depends upon the local circumstances. For detailed costs of plasterers' scaffolding, see Chapter II.

Sacks.—As mentioned in Chapter II., the merchants make a charge for the use of sacks, usually 3d. each, and this must be included in the cost of material.

Lathing.—Occasionally this work is carried out by the plasterer, but can be executed with greater economy by a lathing contractor. Laths are sold by the "bundle," and the number contained in a "bundle" varies in different districts, so that local enquiry is necessary. For the purpose of compiling a detailed cost, it is assumed that after allowing for waste, a "bundle" will produce 100 useful laths, each 3 ft. long.

Detailed Cost of Lathing.—

	£	s	d
¼ "bundle" of laths, at 2s. 3d. .	0	0	6¾
¼ lb. of nails, at 3d. . . .	0	0	0¾
Lather, fixing laths, ¼ hour, at 1s. 8d.			¼
Price per yard super .	£0	0	10½

Laths can be obtained in any length up to 5 ft. in multiples of 6 ins., and the standard thickness is $\frac{1}{8}$ in.

Double laths are those $\frac{1}{4}$ in. thick, and the laths described as "lath and a half" are those which are $\frac{3}{16}$ in. in thickness. One yard super of ordinary lathing requires 25 laths.

Counter-lathing.—To price this item, all that is necessary is to double the rate for ordinary lathing.

Plastering on Laths.—Three-coat work is advisable for ceilings and partitions which have been lathed with ordinary fir laths, although with "Sirapite" often the work is executed in two coats. In any case the finishing coat should not be applied until at least 24 hours after the undercoat, as the wood laths naturally absorb moisture, which causes expansion and contraction. In damp weather it may be necessary to allow 48 hours and even longer, and this fact will affect prices considerably, especially for repair work, or work in small quantities, as it may be necessary for the men to leave the job for a time and return after a few days. On metal lathing an undercoat of Portland cement is advisable.

Expanded Metal Lathing.—This material is described and analysed in "Carpenter"; frequently it is given in "Plasterer," and included with the plastering items. It is often fixed by the carpenter, especially if "blocking out" is necessary.

Plastering Generally.

Thickness of Coats.—The Standard Method of Measurement stipulates that the thickness of two-coat work shall be considered as not exceeding $\frac{5}{8}$ in., and of three-coat work not exceeding $\frac{7}{8}$ in., also that two-coat work in patent plasters shall be taken as not exceeding $\frac{1}{2}$ in. in thickness. This does not include keys in brickwork or spaces in lathing.

In the detailed costs which follow, it will be noted that waste is not shown separately, but it is included by the extra thickness allowed for the separate coats. A certain amount of material is wasted, but the material is reduced in bulk also by the action of trowelling and filling keys. To cover this, it is convenient to take two-coat work as in $\frac{1}{2}$-in. and $\frac{1}{4}$-in. coats, a total of $\frac{3}{4}$ in. thickness for the material for work which actually finishes $\frac{5}{8}$ in. thick. In a similar manner three-coat work is taken as $\frac{1}{2}$ in., $\frac{3}{8}$ in., and $\frac{1}{8}$ in., a total thickness of 1 in. for work which actually finishes $\frac{7}{8}$ in. thick. For patent plasters a thickness of $\frac{5}{8}$ in. will be taken. This will avoid the use of awkward fractions so that calculations can be made mentally, and will cover waste and loss, except in the case of work on laths where an extra allowance is necessary for the material behind and between the laths.

Labour.—It will be noticed that most of the items assume that one labourer can attend upon two plasterers; this is the usual practice, but with certain items is impossible, but for ordinary wall and ceiling plastering there should be no difficulty.

Most of the examples are calculated upon a surface of 9 yds. super for convenience in calculating the labour.

The rate of wages has been taken herein as the standard rate for other trades, but in actual practice it may be necessary to add to this. Plasterers are allowed "expenses" at the following rates, viz.: If the job is 5 miles from the works, 1s. per day; 10 miles, 1s. 6d. per day, and if 15 to 20 miles, 3s. per day.

Work in Lime Mortar.

If the details in Chapter II. are consulted, it will be found that "coarse stuff," at £1 0s. 3d. per yard cube, and "fine stuff," at £1 4s. 3⅜d. per yard cube, work out at 6¾d. and 8¼d. per yard super if 1 in. thick. Other thicknesses can be found by proportion.

Detailed Costs.—

Render in Hair Mortar and Set in Fine Stuff (⅝ in. thickness), otherwise known as "two-coat work.

	£	s.	d.
9 yds. super "coarse stuff," ½ in. thick, at 3¾d.	0	2	6½
9 yds. super "fine stuff," ¼ in. thick, at 2½d.	0	1	6¼
2 plasterers and 1 labourer, 2¼ hours, at 4s. 7¼d	0	10	4¼
Total cost for 9 yds.	£0	14	5¼

Cost per yard super, 1s. 7¼d.

Render, Float, and Set Walls (⅞ in. thickness), otherwise known as "three-coat work."

	£	s.	d.
9 yds. super "coarse stuff," ½ in. thick, at 3¾d.	0	2	6½
9 yds. super "coarse stuff," ⅜ in. thick, at 2½d.	0	1	10½
9 yds. super of "fine stuff," ⅛ in. thick, at 1d.	0	0	9
2 plasterers and 1 labourer, 3 hours, at 4s. 7¼d.	0	13	9¾
Total cost (9 yards) . . .	£0	18	11¾

Cost per yard super, 2s. 1½d.

If work under the above description is required to be ⅝ in. thick, allow ⅜ in. for the first coat, $\frac{3}{16}$ in. for the second, and $\frac{3}{16}$ in. for the third coat.

Lath, Plaster, Float, and Set on Partitions (⅝ in. thick).

	£	s.	d.
9 yds. lathing (see previous detail), at 10½d.	£0	7	10½
9 yds. super "coarse stuff," ⅜ in. thick . }			
9 yds. super "coarse stuff," ⅜ in. thick = total thickness of "coarse stuff," ⅜ in. thick, at 5,1½d. }	0	3	9½
9 yds. super "fine stuff," ⅛ in. thick, at 1d.	0	0	9
2 plasterers and 1 labourer, 3 hours, at 4s. 7¼d	0	13	9¾
Total cost (9 yards) . . .	£1	6	2¾

Cost per yard super, 2s. 10½d.

Allowance has been made for the extra loss of plastering material in the laths.

Lath, Plaster, Float, and Set on Ceilings (⅝ in. thick).

	£	s.	d.
Labour and material as last item	1	6	2¾
Add 10 per cent. on lather's time	0	0	2½
Add 10 per cent. on plasterers' and labourer's time .	0	1	4½
Total cost (9 yards)	1	7	9¾

Cost per yard super, 3s. 1d.

Lath, Plaster, Float, and Set on Sloping Soffits.—Add 5 per cent. on previous example, cost 3s. 2¾d.

Lath, Plaster, Float, and Set on Flewing Soffits.—Add 10 per cent. on ceiling example, cost 3s. 4¾d.

"Rough-cast" or "Pebble-dash."

Rough-cast in Lime Mortar (⅝ in. thick).

	£	s.	d.
Cost of "render and set," as previous item . .	0	1	7¼
¼ ft. cube of pea gravel, at 12s. per yard cube .	0	0	1¼
1 plasterer and 2 labourers, extra time, 10 minutes, at 4s. 7¼d. per hour	0	0	9¼
Cost per yard super	0	2	5¾

Add for scaffold if required and for transport.

Plastering in "Sirapite."

This material is described fully in Chapter II., and its great advantage is the speed at which the work can proceed.

Many practical plasterers prefer a backing of Portland cement and sand, in the proportions of 5 parts of sand to 1 part of cement, finished off with a coat of neat "Sirapite"; this is a superior form of plastering and a detailed cost is given herein. For ceilings, some plasterers prefer to render in "coarse stuff" and finish in "Sirapite," and a detailed cost of this item is given also; the material sets quickly and takes less labour.

If the details in Chapter II. are consulted, it will be seen that coarse "Sirapite," at £2 2s. 10½d. per yard cube, and "finish" Sirapite, at £3 19s. 0½d. per yard cube work out at 1s. 2¼d. and 2s. 2½d. per yard super if 1 in. thick.

Detailed Costs.—

Render and Set in "Sirapite" and Sand, ½ in. thick.

9 yds. super "coarse Sirapite,"	½ in. thick, at 7½d.	£0	4½
9 yds. super "finish" "	⅛ in. thick, at 3⅜d.	0	
2 plasterers and 1 labourer, 1¼ hours, at 4s. 7½d.		0	
Total cost of 9 yds.		£0	16

Price per yard super 1s. 9½d.

Lath, Plaster, Float, and Set in 'Sirapite" on Ceilings, in. thick.

9 yds. lathing (see previous detail), at 10½d.		£0	7
9 yds. super "coarse Sirapite,"	⅝ in. thick, at 8⅞d.	0	6
9 yds. super " "	¼ in. thick, at 1½d.	0	1
9 yds. super "finish" "	⅛ in. thick, at 3⅜d.	0	2
2 plasterers and 1 labourer, 2¼ hours, at 4s. 7½d.		0	10
Add 10 per cent. to lather's time		0	0
Add 10 per cent. to labour		0	1
Total cost of 9 yds.		£1	9

Price per yard super, 3s. 4d.

Sloping Soffits and Flewing Soffits in "Sirapite."—Add 5 per cent. and 10 per cent. respectively as described for Lime Plaster.

Render and Set Walls in Portland Cement and Sand (1 *to* 5), *finished in "Sirapite," ⅝ in. thick.*

If the cost of 1 yd. cube of cement rendering (1 to 5) is worked out in a similar manner to the 1 to 3 and 1 to 2 mixes detailed in Chapter II. (Bricklayer), it will be found to amount to £1 17s. The decrease in bulk for this mix necessitates an addition of 50 per cent.

The cost per yard super 1 in. thick is 1s. 0½d.

Detailed Cost.—

9 yds. super cement and sand (1 to 5),	⅝ in. thick, at 7⅞d.	5	9⅞
9 yds. super "finish Sirapite,"	⅛ in. thick, at 1½d.	1	3⅜
2 plasterers and 1 labourer, 2 hours, at 4s. 7½d.		9	2½
Total cost of 9 yards		16	4

Cost per yard super 1s. 9⅞d.

The work described in this analysis is very suitable for work on expanded metal, and in this case the cement and sand should be calculated as ⅞ in. thick.

Lath, Plaster, Float, and Set on Ceilings in "Coarse Stuff," finished in "Sirapite," $\frac{3}{4}$ in. thick.

	£	s.	d.
9 yds. lathing, at 10½d.	£0	7	
9 yds. super total thickness of two coats of "coarse stuff," $\frac{7}{8}$ in. thick, at $5\frac{1}{16}$d.			9½
9 yds. super "finish Sirapite," $\frac{1}{8}$ in. thick, at 1$\frac{3}{4}$d.			3¾
2 plasterers and 1 labourer, 2$\frac{3}{4}$ hours, at 4s. 7½d.	0	12	7¾
Add 10 per cent. lather's time	0	0	
Add 10 per cent. plasterer's time	0	1	
Total cost of 9 yards	£1	7	1

Cost per yard super, 3s.

If the last item was on expanded metal lathing, the cost would be increased by 9d. per yard super (see "Carpenter" for expanded metal).

Work in Fine Plaster.

Cornices and Mouldings.—These are run in "fine" plaster which consists of plaster of Paris and plasterer's putty: the cost per yard cube is analysed in Chapter II. The screeds or backings are of "coarse stuff," with plaster of Paris added.

If a detail of the design is not available, the pricing of this item is speculative. Many practical men price cornices at a figure based upon a datum per inch of girth.

Cornices require two plasterers, as one places the material in position and the other man follows behind and works the material; one labourer can attend upon the two plasterers.

The following detailed costs are based upon lengths of 100 ft.:

Detailed Cost.—

Plaster Moulded Cornice, 20 ins. Girth.

	£	s.	d.
14 ft. cube "coarse stuff" and plaster of Paris, at £1 os. 3d. per yard cube	£0	10	6
30 ft. cube "fine" plaster, at £1 os. 2d. per yard cube	1	2	6
	£1	13	0
Waste, 12½ per cent.	0	4	1½
	£1	17	1½
Use and waste of running rule and battens (see later)	0	3	3
Carpenter, cutting and making mould, 4 hours, at 1s. 8d.	0	6	8
Timber and zinc for ditto (say)	0	1	6
2 plasterers and 1 labourer, 45 hours, at 4s. 7½	10	7	2½
Total cost	£12	15	9

Dividing by 100 gives the price per foot run of 2s. 6¾d.

It will be noted that the above price is equivalent to 1½d. per inch girth per foot run.

The battens for screeds for 100 ft. run of cornice cost 9s. 9d. (timber at 3s. 6d. per foot cube), and one-third of this has been taken, as it is assumed the material will be used but three times.

The cost of the "coarse stuff" mixed with plaster of Paris has been taken at the price of "coarse stuff," the difference in price being negligible for the small proportion of the latter material. A cornice 20 ins. in girth will project about 10½ ins. and in depth will measure about 12 ins.; a student therefore can check the calculation for himself. The total amount of material is 44 ft. cube, and the analysis is based upon one-third of this being "coarse stuff." No details will be given for enriched cornices as the prices vary so considerably with the design, but it may be noted that the labour will be about 50 per cent. more.

Detailed Cost.—

Plaster Moulded Cornice, 9 ins. Girth.

	£	s.	d.
3 ft. cube "coarse stuff" and plaster of Paris, at £1 os. 3d. per yard cube	0	2	3
6 ft. cube "fine" plaster, at £1 os. 2d. per yard cube	0	4	6
	£0	6	9
Waste, 12½ per cent. .	0	0	10
	£0	7	7
Use and waste of rule and battens, as before	0	3	3
Carpenter cutting mould, as before . .	0	6	8
Timber and zinc for ditto	0	1	0
2 plasterers and 1 labourer, 20¼ hours, at 4s. 7½d.	4	13	2¼

Dividing by 100 gives the price per foot run of 1s. 1½d.

The above price also works out at 1½d. per foot run for every inch in girth.

The quantity of material is much less than the previous example as the cornice will project 6½ ins. only.

Labour Data, Cornices, and Coves.—The two previous detailed costs are based upon the datum that two plasterers assisted by one labourer take 2¼ hours per inch of girth to run 100 lintel feet of cornice. For coves and bracketed cornices the period will be taken as 2 hours per inch of girth.

Coves.—These are not so difficult as cornices, less material is required and the labour is less.

Detailed Cost.—

Plaster Cove, 9 ins. Girth.

	£	s	d
1½ ft. cube "coarse stuff" and plaster of Paris, at £1 os. 3d. per yard cube	0	1	1½
3 ft. cube "fine" plaster, at £1 os. 2d. per yard cube	0	2	3
	£0	3	4½
Waste, 12½ per cent.	0	0	5
	£0	3	9½
Rules and battens, as before	0	3	3
Carpenter, cutting and making mould, 3 hours, at 1s. 8d.	0	5	0
Timber and zinc for ditto	0	1	0
2 plasterers and 1 labourer, 18 hours, at 4s. 7½d.	4	2	10½
Total cost	£4	15	11

Dividing by 100 gives the price per foot run of 11½d.

This is equivalent to 1¼d. per foot run for every inch in girth.

Bracketed Cornices.—Scotch bracketing consists of wood brackets cut, fixed, and spaced at intervals of 18 ins. and then covered with laths so as to form a backing for the plaster. The weight is less than solid cornices and less plastering material will be required.

A cornice 30 ins. in girth would project about 18 ins. and in depth would measure 15 ins. The triangular brackets would measure about 15 ins. by 11 ins., and two fillets would be required, one fixed to the ceiling and one to the wall to which the brackets would be spiked.

Although the actual work in forming the bracketing is done by the carpenter it is included in the plasterer's item (see Standard Method of Measurement—Plasterer—Clause 8).

Detailed Cost.—

Plaster Moulded Cornice, 30 ins. Girth, on and Including Fir Scotch Bracketing.

	£	s	d
200 ft. run 2″ × 1″ fillet, at 16s. per 100 ft.	£1	12	0
68 fir brackets out of 11″ × 1½″ (15 ins. long), at 5d.	1	8	4
6 lbs. nails, at 3d.	0	1	6
	£3	1	10
Add for waste, 5 per cent.	0	3	1
Fixing, 2 carpenters and 1 labourer, 5 hours, at 4s. 7½d.	1	3	0½
Lathing, 8½ yds., at 11½d. (10½d. plus 10 per cent.)	0	7	11¾
14½ ft. cube "fine" plaster, at £1 os. 2d. per yard cube	0	10	10¾
2 plasterers and 1 labourer, 60 hours, at 4s. 7½d.	13	16	3
Total cost	£19	3	0¾

Dividing by 100 gives the price per foot run of 3s. 10d.
This figure works out at 1½d. per inch of girth per foot run.

Work in Keene's Cement and Parian.

This work is often priced as "extra only," as all backings to Keene's cement or Parian are usually in Portland cement and sand. The material at present costs about £6 per ton, and the detailed cost of one yard cube prepared for use will be found in Chapter II. amounting to £5 15s. 9½d. This works out at 3s. 2½d. per yard super 1 in. thick.

The finishing coat consists of neat Keene's cement, but occasionally for high-class decorative work, an undercoat of Keene's cement and sand is specified.

Detailed Costs (*Areas of 9 yds. super*).—

Setting Coat of Neat Keene's Cement (on Portland cement backing taken elsewhere).

9 yds. super Keene's cement, ⅛ in. thick, at 4¾d. .	£0		
2 plasterers and 1 labourer, 1¼ hours, at 4s. 7½d. .	0		
Total cost . .	£0	9	3¾

Price per yard super, 1s. 0½d.

Float in Keene's Cement and Sand (6 parts of sand to 2½ parts of Keene's cement) *and set in neat Keene's Cement.* Total thickness, ⅝ in.

If the cost of 1 yd. cube of the sand and Keene's is worked out as described for Portland cement (in Chapter II.), the price will be £2 2s. per yard cube or 1s. 2d. per yard super 1 in. thick.

9 yds. super sand, Keene's, ⅜ in. thick, at 8¾d.	£0	6	6¾
9 yds. super Keene's, ⅛ in. thick, at 4¾d. .	0	3	6¾
2 plasterers and 1 labourer, 2½ hours at, 4s. 7½d.	0	11	
Total cost	1		7½

Price per yard super, 2s.

The above item is for high-class work, and will give a surface that can be decorated immediately. A backing of Portland cement is required in addition.

"*Keene's Cement Angle.*"—It is usual to specify for all salient angles to plastering work (except "Sirapite" and other

hard plasters) to be run in Keene's, and in a Bill of Quantities the work is priced per foot run.

The space occupied by the Keene's cement is not more than 6 ins. wide, and from the previous cost it is a simple matter to calculate the price.

	£	s.	d.
1 yd. super in Keene's and sand, as last item . .	£0	2	3½
Add 50 per cent. to labour and materials for waste and for being in "small quantities" . . .	0	1	1¾
	£0	3	5¼
Less cost of finishing coat of ordinary plastering .	0	0	3½
Cost per yard super	£0	3	1¾

As a length 12 ins. long and 6 ins. wide is $\frac{1}{18}$ yd. super, dividing the above total by 18 gives the price per foot run of 2d.

Work in Roman Cement.

This material, although not used to the same extent as formerly, is still of use when executing repairs to old painted stucco work, for rendering over old stone that has been affected by the weather, and in external situations where it is required to paint the surfaces immediately. As detailed in Chapter II. the cost of 1 yd. cube of undercoat is £3 12s., and of finishing coat, £4 3s. 1½d., which works out at 2s. and 2s. 3¾d. respectively per yard super 1 in. thick. For an area of 9 yds. super the following will be necessary :—

Render and Set in Roman Cement, ½ in. thick, finished with hard float.

	£	s.	d.
9 yds. super undercoat (see Chapter II.), ½ in. thick, at 1s.	£0	9	0
9 yds. super finishing coat (see Chapter II.), ⅛ in. thick at 3½d.	0	2	7½
2 plasterers and 1 labourer, 3 hours, at 4s. 7½d. .	0	13	9¾
Total cost	£1	5	5¼

Price per yard super, 2s. 11¼d.

Work in Portland Cement.

From the details given in Chapter II. (Bricklayer), it will be found that the 1 to 3 mix amounts to £1 18s. 8d. per yard cube and the 1 to 2 mix at £2 1s. per yard cube. This works out at 1s. 0¾d. and 1s. 2d. respectively per yard super 1 in. thick.

Detailed Costs.—

Render and Float in Portland Cement and Sand (1 *to* 2), $\frac{5}{8}$ *in. thick, as bed for Keene's Cement or as Screed for Tiling.*

	£	s.	d.
9 yds. super cement mortar, $\frac{5}{8}$ in. thick, and 9 yds. super ditto, $\frac{1}{8}$ in. thick, equals 9 yds. super, $\frac{3}{4}$ in. thick, at 9½d.	0	7	3¾
2 plasterers and 1 labourer, 3 hours, at 4s. 7½d.	0	13	9½

Cost per yard super, 2s.

Render and Set in Portland Cement and Sand (1 *to* 3), $\frac{5}{8}$ *in. thick.*

	£	s.	d.
9 yds. super of a total thickness of $\frac{3}{4}$ in. of cement and sand, at 10½d.	0	7	10
2 plasterers and 1 labourer, 3 hours, at 4s. 7½d.	0	13	
Total cost	1	1	8

Cost per yard super, 2s. 5d.

Render and Set in Portland Cement and Sand (1 *to* 3), $\frac{3}{4}$ *in. thick, and jointed as Ashlar Stone.*

	£	s.	d.
Cost per yard super, as last item	0	2	5
Add plasterer and labourer, extra time, per yard super, ⅛ hour, at 4s. 7½d.	0	0	9½
Cost per yard super	0	3	2½

White and Coloured Portland Cement.

("Snowcrete" and "Cullamix.")

This material is described and analysed in Chapter II. (Plasterer). The costs per yard cube for the undercoats taken therefrom is £2 9s. 5d. and for finishing coat £6 5s. 3¾d., which works out at 1s. 4½d. and 3s. 5¾d. respectively per yard super 1 in. thick. The "Snowcrete" mixture contains the aggregate.

Detailed Cost.—

Render and Float in "Water-Repellent" Cement and Sand (1 *to* 3), *and finish in "Snowcrete" mixture, total thickness,* $\frac{7}{8}$ *in.*

	£	s.	d.
9 yds. super two coats of cement and sand, $\frac{7}{8}$ in. thick, at 1s. 2½d.	0	10	10½
9 yds. super "Snowcrete" rendering mixture, ⅛ in. thick, at 5¼d.	0	3	11¼
2 plasterers and 1 labourer, 3 hours, at 4s. 7½d.	0	13	9½
	1	8	7½

Cost per yard super, 3s. 2d.

Waterproofed Portland Cement.

This material is analysed and priced in Chapter II.

Detailed Cost.—

Render and Set in Portland Cement and Sand (3 *to* 1), *gauged with "Pudlo" Brand Waterproofer,* 3 *per cent.* (*by weight*), *to Portland Cement, total thickness,* $\frac{3}{4}$ *in.*

1 yd. super material, $\frac{3}{4}$ in. thick (see Chapter II.), at £3 18s. 4½d. per yard cube	£0	1	7½
2 plasterers and 1 labourer, ½ hour, at 4s. 7½d. .	0	1	6½
	£0	3	2

The above example illustrates a suitable method of treating walls internally for dampness.

Fibrous Plaster.

This material frequently takes the place of plaster worked *in situ*, especially for moulded cornices, but often fibrous plaster slabs are used for plain work. It is impossible to give but a very rough idea of cost for this class of work, but the following allowances are suggested, viz. :—

For plain slabs allow for one skilled man and one labourer to assist 15 minutes per yard super, and for ornamental work, 20 minutes per yard super.

Prices for the material should always be obtained from specialist contractors.

Cornices work out at about the same price as ordinary plaster moulded cornices, and the only advantage is the less amount of time required for setting.

Compared with the previous datum of 3s. 1d. for the item "Lath, plaster, float, and set ceilings," the cost of fibrous plaster slabs fixed complete with galvanised nails, joints stopped with "coarse stuff" and finished in fine stuff, would work out at the same price, but less time would be taken to complete the job.

Plaster Partition Slabs.

These slabs although more expensive than breeze concrete blocks are frequently used because of their lightness. They can be cut with a saw. They are usually billed in "Plasterer,"

but frequently a bricklayer fixes. Being larger than breeze blocks and weighing less, the labour fixing is less than with heavier blocks. For a detailed cost assume a wall 12′ × 6′, i.e. 8 yds. super.

Detailed Costs.—

Plaster Partition Slabs, 2 ins. thick, jointed in Cement Mortar (1 *to* 3).

	£	s.	d.
8 yds. super of plaster slabs, at 1s. 6d. per yard	0	12	0
Add for waste, 2½ per cent. . . .	0	0	3½
Unloading, 2 labourers, ½ hour, at 2s. 6½d. .	0	1	3½
1 ft. cube of cement mortar for jointing, at £1 18s. 8d	0	1	5
Fixing, plasterer, (or bricklayer) and labourer, 3 hours, at 2s. 11½d.	0	8	9½
	£1	3	9½

Dividing the above total by 8 gives the price per yard super of (say) 3s.

Plaster Partition Slabs, 3 ins. thick, jointed in Cement Mortar (1 *to* 3).

	£	s.	d.
8 yds. super slabbing, at 2s. 2d. per yard . .	0	17	4
Add for waste, 2½ per cent.	0	0	5½
Add for unloading, as before	0	1	3½
1½ ft. cube of cement mortar for jointing, at £1 18s. 8d.	0	1	10½
Fixing, plasterer (or bricklayer) and labourer, 3½ hours, at 2s. 11½d.	0	10	3½
	£1	11	2½

Dividing the above total by 8 gives the price per yard super of 3s. 10½d.

Labour and Waste Items on Plaster Slabs.

Pin up to Soffits, etc. (per foot run).—Allow $\frac{1}{18}$ yd. super for waste, and extra labour, 3 minutes.

Pin up to Ditto, but Raking (per foot run).—Allow $\frac{1}{9}$ yd. super for waste, and extra labour, 3 minutes.

Straight Cutting.—Allow as described for "pin up."

Raking Cutting.—Allow as described for "pin up, but raking.

Extra Labour in Forming Openings.—Allow 1 yd. super for waste, and ¾ hour for labour.

CHAPTER XV.

GLAZIER, PAINTER, DECORATOR, AND PAPERHANGER.

GLAZIER.

THIS simple trade needs little explanation, but it is impossible to price the items accurately unless the approximate sizes of the different squares are given, as described in the Standard Method of Measurement, and the following data are submitted for ordinary sheet glass for cutting and glazing :—

Squares not exceeding 1 ft. super . .	5 ft. per hour.
„ 1 to 2 ft. super . . .	4½ „ super per hour.
„ 2 to 4 „ „ . . .	3½ „ „ „
„ 4 to 6 „ „ . . .	3 „ „ „

For putty an allowance of 1 lb. for every 12 ft. super should be sufficient ; at present the price is 14s. per cwt.

Detailed Cost.—

21 ozs. Sheet Glass and Glazing in Squares, exceeding 4 ft. but not exceeding 6 ft. super.

6 ft. super of 21 ozs. sheet glass, at 4d. . . .	£0	2	0
Putty, ½ lb. at 1½d.	0	0	0¾
Glazier, 2 hours, at 1s. 7d.	0	3	2
	£0	5	2¾

Dividing the above by 6 gives the price per foot super of 10½d. For plate glass and similar weights, allow double the above time.

No other detailed costs will be given in this trade, as the charges for glass, especially plate glass, are governed by a tariff, and the glass merchants will always supply builders with a booklet giving details of the various charges for glass of various descriptions, and the cost of cutting, polishing, and bevelling. The price of glass per foot super varies considerably in accordance with the sizes of the sheets ; large sheets are much more expensive in proportion than small ones.

Plate Glass costs from 1s. 6d. to 6s. 1d. per foot super, in accordance with the dimensions of the sheets ; and plate glass, suitable for silvering, costs from 2s. 6d. to 7s. 1d. per foot super.

Sheet Glass costs from 3d. to 8½d. per foot super.

The student is advised to obtain a copy of the "Glass Guide," published by the leading glass merchants; this will give the prices for the different sizes.

Leaded Lights.—Quotations should be obtained, as leaded lights cost from 2s. 6d. per foot super upwards.

Painting Work.—This is not a difficult bill to price, and in consequence it is often the last one priced, and is then priced hurriedly. With new buildings it is not an important bill, the painter's work being such a small percentage of the whole job, but with Bills of Quantities, consisting principally of painting work, or for alterations and repairs, it becomes necessary to give careful attention to this particular trade. Its importance is not always appreciated, but in point of fact it is the principal maintenance trade, for all painted work requires attention periodically. Interior work usually requires repainting every seven to ten years, and exterior work at least every three or four years.

The painter's work not only consists of painting, enamelling, or varnishing surfaces usually so treated, but also applying "Duresco," "washable" distempers, and ordinary distempering and lime-whiting. Formerly the latter items were included in the plasterer's bill, but now it is a Trade Union regulation for this work to be performed by the painter, and the proper course is to include such work in the painter's bill. The application of tar, creosote, and "Solignum" should also be included in this bill.

Repair Work or Maintenance.—When pricing work to surfaces previously painted, it must be borne in mind that in many cases the rubbing down and the preparation of such surfaces will cost more than the price of a coat of paint; in fact, with old surfaces, a good preparation can cost twice the value of one coat. In many cases, for very old woodwork, it may be necessary to add 50 to 75 per cent. to the ordinary prices.

Painter's Plant.—The wear and tear regarding painter's plant is considerable. Brushes, sponges, and leathers require constant renewal, although much depends upon the way brushes are cleaned and preserved. Accurate cost-keeping is necessary to find the exact amount which should be allowed, as this depends upon the class of work executed by the firm. The writer recommends an addition to all prices for painter's work of at least 5 per cent. for depreciation of plant.

Covering Capacity of Paint.—In considering the question of paint, much depends upon the covering capacity of the material, and the student has no doubt discovered that manufacturers of the various patent materials claim special properties for their particular commodity, and that many of the comparative costs submitted by the different makers, and as published in various text-books, differ to a considerable extent. Unfortunately the comparisons made are frequently based upon data which do not occur often in actual practice; the data in many text-books are based upon the assumption that the material is chemically pure, whereas every practical man knows commercial white lead and other materials used by the painter contain other ingredients in different proportions, and these affect the covering capacity of the mixed material, and the time taken in applying such material. Pigments especially contain impurities which can reduce the covering capacity and the opacity of the finished coat of paint. It is also necessary to allow for waste. The cost of the material is such a small proportion of the total cost that it is false economy to purchase cheap pigments.

Zinc Paints.—In consequence of legislation, the use of white lead will in course of time be restricted, and efforts are being made to entirely prohibit such use. There is no doubt that for certain work a substitute can be used, and up to the present the best substitute known is zinc oxide. White lead paint is still used for exterior work. In Chapter II. data for mixed zinc paints are given, but in comparing such with other published data, the student must use considerable discretion. In the opinion of the writer, the unit usually taken for comparing the cost of zinc paints with white lead paints is not the correct one. It is often claimed that the covering capacity of zinc white is about 25 per cent. more than white lead, but this figure is based upon the weight of the raw material, and white lead is heavier than zinc oxide. The writer considers that the comparison as regards cost should be made between the covering capacity of a gallon of white lead paint and a gallon of zinc oxide paint, and that comparison should be made as regards opacity, for in many cases it will be found that three coats of zinc oxide paint will be necessary to produce a result equal to two coats of white lead paint. Another substitute has been upon the market for several years known as Lithopone. Lithopone is a combination of zinc sulphide and

barium sulphate; it differs considerably from zinc oxide, and it must not be confused with such material. Apparently the ideal material as a substitute for white lead would be something containing the best properties of both zinc compounds. The material known as "Charlton white" is a commercial form of Lithopone, and it is believed to have more body and greater covering power than white lead. In preparing costs (and in practice) it must not be forgotten that ordinary driers must not be used with zinc paints, the manufacturers will supply a special drier if required. A drier composed of manganese is very suitable, but any drier containing lead (and most of them do contain lead in some form) is unsuitable for zinc paints.

Ready-mixed Paints and Undercoats.—As mentioned in Chapter II., the use of ready-mixed materials is becoming more common than formerly; many architects prefer to specify certain brands. If the material is supplied by a firm of repute, in many instances the paint will be of better quality than the builder can prepare himself. The various undercoats for enamel now upon the market are usually zinc compounds, and cost about 21s. per gallon. To obtain the full benefit of the price for ready-mixed paint the builder must purchase in bulk, and at present the price works out at about 77s. per cwt. In making comparisons, it must be remembered that the ready-mixed paint can usually be thinned-out with oil and "turps" to bring it to the same weight detailed in Chapter II. (for the preparation of a gallon of paint).

Exterior Work.—In estimating for the painting of exterior work, the cost of the plant and perhaps a scaffold must be considered, and if travelling cradles are required, the cost of the hire or use of the plant will in many instances amount to more than the cost of the actual painting work. In H.M. Office of Works Schedule for Painting Work, an allowance of 12½ per cent. is added to the prices given for interior work to cover this extra cost for exterior work, but in the opinion of the writer this is insufficient, and the following percentages should be added to ordinary prices to cover the extra cost of exterior painting, viz. :—

External work on ground and first floors . .	12½	per cent.
,, ,, second floor . . .	15	,,
,, ,, third floor . . .	20	,,
,, ,, fourth floor and above . .	25	,,

Work Priced per Foot Super or per Yard Run.—The price per foot super is found by dividing the price per yard super by 9, and when the width is known, the price per yard run can easily be found by proportionate methods; but to this price about 20 per cent. should be added, owing to the work being "in small quantities." For example, take the item "Knot, prime, stop, and paint three oils on 6-in. narrow widths." If the price per yard super for "Knot, prime, stop, and three oils" is 2s. 0½d., adding 20 per cent. to this brings the price up to 2s. 5½d.; dividing by 6 gives the price of 5d. per yard run for a width of 6 ins. The 1935 Standard Method of Measurement states that running dimensions are now to be billed by the *yard* run.

Work Priced per Number.—Sash and casement sheets and squares are numbered items, and in order to find the price it is necessary to find the approximate number of superficial yards contained in such item, and to add a percentage usually about 20 per cent. for the "cutting-in."

Painting Ironwork.—This can be worked out as described for other work, bearing in mind, however, that no knotting and stopping are necessary. If scraping and rubbing with dandy brushes is necessary (as with old surfaces), allow per yard super ½ hour for labourer.

Painting Plastered Work.—To allow for suction, add 25 per cent. to the cost of material required for the first coat, and 10 per cent. to cost of material for the second coat. The first coat of sharp colour should, of course, follow the trowel. If the plastered surface is old, an amount up to 25 per cent. should be added to the cost of labour to pay for the extra preparation, and the cost of stopping should be added as described later (for preparing surfaces preparatory to distempering).

Data for Pricing.—The quality of the material, as well as the cost of labour, varies considerably with the class of work, and in accordance with the nature of the surface to be painted; the data given later are intended to apply to new work of good quality, and in dealing with other work the prices must be adjusted accordingly. The prices of lead, oil, and turpentine (the principal materials used by the painter) vary from time to time in accordance with market fluctuations, therefore quotations must be obtained from time to time for painters' material. With new work the principal operations are knotting, priming,

stopping, and painting (the number of coats being specified), but other materials, such as varnish and enamel, are applied over the coats of paint, or over a patent undercoating. It is extremely difficult to work up the cost for a single superficial yard, or to visualise the operation for so small a surface, therefore the data following have been calculated upon surfaces of 100 yds. super. In certain districts it is possible to arrange for the preparatory work to be carried out by labourers, which will effect a saving.

Painter's Work.—

Description of Work.	Labour.	Material.
KNOTTING	Painter, 6 hours.	1 pint patent knotting.
PRIMING (lead)	,, 17 ,,	2 gall. priming.
,, (zinc)	,, 17 ,,	1 ,, ,,
STOPPING	,, 6 ,,	4 lbs. dry white lead; 1 pint gold size.
PREPARING (new work)	Painter or labourer, 10 hours.	2 lbs. pumice.
,, (old work)	Painter or labourer, 30 hours.	3 lbs. pumice; 2 doz. sheets waterproof glasspaper.
1ST and 2ND COATS (lead)	Painter, 20 hours.	1½ galls. lead paint.
1ST COAT (zinc)	,, 14 ,,	1 gall. zinc paint.
2ND, 3RD, AND 4TH COATS (zinc)	,, 11 ,,	1 ,, ,,
3RD AND 4TH COATS (lead)	,, 15 ,,	1½ ,, lead paint.
UNDERCOATING (for enamel)	,, 20 ,,	1 ,, undercoat.
ENAMELLING	,, 15 ,,	1½ ,, enamel.
VARNISHING (per coat)	,, 15 ,,	1 ,, varnish (up to 1½).
FELTING DOWN (for ditto)	,, 20 ,,	—
GRAINING	,, 25 ,,	¼ ,, stainings.
STAINING	,, 10 ,,	½ ,, stain.
SCUMBLING	,, 20 ,,	½ ,, ,,
PREPARING TO IMITATE ANTIQUE WORK	,, 23 ,,	—
DISTEMPERING (1 coat)	,, 12 ,,	12 lbs. whiting; ½ lb. dry colour; 1 firkin of size.
,, (2nd coat)	,, 10 ,,	Material as last item.
WASHING-OFF, STOPPING, AND PREPARING OLD WORK FOR DISTEMPER	,, 12 ,,	½ bushel of Keene's cement; 1 pint of white knotting.
APPLYING "DURESCO" AND "WASHABLE" DISTEMPERS 1st coat	,, 18 ,,	14 lbs. distemper; ¾ gall. of petrifying liquid.
2nd ,,	,, 16 ,,	7 lbs. distemper; ½ gall. liquid.
2nd ,, (stippled)	,, 20 ,,	

The above quantities of materials allow for waste.

The detailed costs of mixing white lead paint and zinc white paints are contained under the headline "Painter" in Chapter II. The painter's rate of wages is 1d. per hour less than other craftsmen.

Writing.—The cost of writing ordinary letters is 2½d. per inch in height, or 3d. if in gold.

Writing Fascias.—This work costs about 12s. per foot super.

Gilding.—Prices vary, but 10s. to 12s. per foot super is a fair average.

PAINTING.

Detailed Costs.—

Knot, Prime, Stop, and Paint three oils on Woodwork.

	£	s	d
Material—			
(a) Knotting, 1 pint, at 2s. per pint	0	2	0
(b) Priming, 2 galls., at 9s. 5d.	0	18	10
(c) Stopping, 1 pint gold size, at 1s. 7d.	0	1	7
4 lbs. dry white lead, at 4½d. . .	0	1	7
½ lb. pumice, at 8d. . . .	0	0	2
(d) 1st coat—1½ galls. paint, at 10s. 8d.	0	16	0
(e) 2nd coat—1½ galls. ditto, at 10s. 8d.	0	16	0
(f) 3rd coat—1½ galls. ditto, at 11s. 0½d.	0	16	6¾
Labour—			
(a) 6 hours; (b) 17 hours; (c) 6 hours; (d) 20 hours; (e) 15 hours; (f) 12 hours—total for painter, 76 hours, at 1s. 7d.	6	0	4
Depreciation of plant—allowing 5 per cent. . .	0	9	8
	£10	2	8¾

Dividing the above total by 100 gives the price per yard super of 2s. 0¼d.

Rub down, prepare, and paint with two coats of best oil and lead colour, and apply one coat of first quality enamel to all woodwork previously painted.

	£	s	d
Material—			
(a) Rubbing down and preparation—			
1 lb. pumice, at 8d.	0	0	8
2 doz. sheets waterproof glasspaper, at 2s. per quire	0	2	0
(b) 1st coat—1½ galls. paint, at 10s. 8d. . .	0	16	0
(c) 2nd coat—1½ galls. ditto, at 10s. 8d. . .	0	16	0
(d) Enamelling—1½ galls. of enamel, at 20s. per gallon	1	6	8
Labour—			
(a) 30 hours; (b) 20 hours; (c) 15 hours; (d) 15 hours—total for painter, 80 hours, at 1s. 7d. .	6	6	8
Depreciation of plant—allowing 5 per cent. . .	0	9	10
	£9	17	10

Dividing the above total by 100 gives the price per yard super of 1s. 11¾d.

Rub down, prepare, and paint with three coats of Zinc Oxide, and apply one coat of first quality enamel to all woodwork previously painted.

Material—			
(*a*) Rubbing down, etc., all as previous item . .	£0	2	8
(*b*), (*c*), and (*d*) 1st, 2nd, and 3rd coats—3 galls. zinc oxide paint, at 12s. 5½d.	1	17	4½
(*e*) Enamelling—enamel as in previous item . .	1	6	8
Labour—			
(*a*) 30 hours; (*b*) 14 hours; (*c*) 11 hours; (*d*) 11 hours; (*e*) 15 hours—total for painter, 81 hours, at 1s. 7d. . . . . :	6	8	
Depreciation of plant—allowing 5 per cent. . .	0	10	

Dividing the above total by 100 gives the price per yard super of 2s. 0¾d.

Prepare and paint Cast-iron Gutters (4″ × 3″), *three coats of paint, inside and outside.*

(*Note.*—The following calculation is based upon 100 yds. super of ironwork) :—

Material—			
(*a*) 1st (priming) coat, 1½ galls. priming, at 9s. 5d. .	£0	14	1½
(*b*) 2nd coat, 1½ galls. paint, at 10s. 8d. . .	0	16	0
(*c*) 3rd coat, 1½ galls. of paint, at 11s. 0½d. . .	0	14	8½
Labour—			
(*a*) 20 hours; (*b*) 15 hours; (*c*) 12 hours—total for painter 47 hours, at 1s. 7d.	3	14	5
Depreciation of plant—allowing 5 per cent. . .	0	5	11½

Dividing the above total by 100 gives the price per yard super of 1s. 3d.; but gutters are priced per yard run (for inside as well as outside). O.G. gutter, 4″ × 3″, works out at 1 ft. 6 ins. girth, therefore one yard run is worth the price of half one yard super (because 1 ft. 6 ins. is half of one yard in length). An addition of 10 per cent. should be made as the work is in narrow widths, making a total of (say) 8d. per yard run.

DISTEMPERING.

Distemper Ceiling, One Coat.

	£	s	d
Labour, 2 painters, 6 hours, at 3s. 2d.	0	19	0
Material—			
12 lbs. whiting, at ½d.	0	0	6
Colouring matter, blue or ochre, ½ lb., at 4d.	0	0	2
1 firkin of size, at 3s.	0	3	0
Depreciation of plant, 5 per cent.	0	1	1½

Dividing the above by 100 gives the price per yard super of 3d.

Wash-off, Prepare, Stop, and Distemper Ceiling, two coats.

	£	s	d
Labour, 2 painters, 17 hours, at 3s. 2d.	2	13	10
Material—			
½ bushel of Keene's cement, at 4s. 1½d. per bushel			0¾
1 pint white knotting, at 2s. per pint			0
24 lbs. whiting, at ½d.			0
½ lb. dry colour, at 4d.			2
2 firkins of size, at 3s. each			0
Depreciation of plant, 5 per cent.			
	£3	8	3¼

Dividing the above total by 100 gives the price per yard super of 8¼d., but to this must be added the cost of scaffold if required.

Apply one coat of Petrifying Liquid and two coats of Washable Distemper to Walls (new walls) :—

	£	s	d
Labour, 2 painters, 24 hours, at 3s. 2d.	3	16	0
1 gall. petrifying liquid (1st coat)	0	3	8
1 gall. ditto (2nd and 3rd coats)	0	3	8
21 lbs. "washable" distemper, at 6os. per cwt.	0	11	3
Depreciation of plant, 5 per cent.	0	0	8¾
	£4	15	3¾

Dividing the above total by 100 gives the price per yard super of 11½d., but if scaffolding is needed the cost must be added.

If the work as detailed is in regard to old walls, then the cost of preparation must be added, and this can be obtained from the datum given earlier for distempering old walls.

The whole of the data given for distempering and the application of "washable" distempers must be used with caution, as the rate of suction on different kinds of plaster

varies considerably, and certain tints require more material to obtain the requisite depth of tone.

Size.—One firkin of size weighs 28 lbs.

Whiting.—Whiting is sometimes sold by the "lump," and two dozen lumps weigh 1 cwt.

French Polishing.

This work varies considerably, but the writer recommends the following be allowed, viz. :—

¾ gall. of French polish per 100 yds. super, and 80 hours for labour. Assuming the polisher's rate is 1s. 8d. per hour, this gives a total of £7 2s. 4d., which, divided by 900, gives the price per foot super of 2d. All items of polisher's work are given in *feet* including the running items.

Paperhanger.

This is a simple trade to price, but not always an easy one to measure, especially with regard to staircases. Many people under-estimate the number of pieces of paper required, and do not realise that no horizontal joints are permitted, and that lofty rooms and staircase wells cause a considerable amount of waste. A roll of English wallpaper is 36 ft. in length, therefore the only correct method of measuring is to find the height of the flank to be papered, and to this add 18 ins. for waste in matching pattern, then dividing this amount into 36 ft. will give the number of useful lengths obtainable from a roll. To find the number of lengths required for a room, divide the running length of the wall flanks by 21 ins. (which is the width of the paper), and divide this total number of lengths by the number of lengths obtainable from one roll which will give the correct number required for the room. Odd parts of a roll must be counted as full rolls, and deductions can be made for large windows and doors, but nothing should be deducted for fireplace openings. It will be noticed that wall flanks 8 ft. 6 ins. to 10 ft. in height cause a great amount of waste. The lengths required for staircase wells should be tabulated in their different dimensions, and calculated separately from rooms, and to each length add an additional 2 ft. for extra waste in cutting to rake.

The actual prices of paper are generally given as P.C. amounts and the hanging is often sub-let to piece-workers.

In a Bill of Quantities it is usually assumed that all papers chosen will be English measurement, but if foreign wallpapers are chosen, the prices must be amended accordingly. The stripping and preparation of old walls for papering is usually carried out by painters, although in some districts labourers are permitted to do this work. Stripping and preparing old walls is usually billed per piece, but in compiling data it is advisable to base the calculations on the superficial area of, say, 100 yds. super.

Sizes of "Pieces" of Paper.—English piece, 12 yds. long and 21 ins. wide.

French piece, 8 yds. long and 18 ins. wide.

American piece, 8 yds. long and 21 ins. wide; also 16 yds. long and 21 ins. wide.

Labour, Hanging Paper.—Per piece (English), including all trimming.

Common or lining papers	1 hour.
Silk fibres and similar papers	1¼ hours.
Sanitary papers	1½ ,,
Ingrains and Moiré papers	1¾ ,,
Raised material	

Preparation of Old Walls for Papering.—Per 100 yds. super.

Labour, painter, 20 hours.
Material—½ bushel of Keene's cement; 1 pint white knotting; 1 firkin of size.

As the preparatory work is billed per piece, the price per yard super can be adapted by taking a piece of paper as equivalent to 6 yds. super.

Detailed Costs.—

Strip and prepare Walls, and provide, trim, and hang Wall-paper as selected at 5s. per piece.—For the purpose of preparing this cost, a room equal to 60 yds. super, requiring ten pieces of paper, is assumed.

Preparation—		
2 painters, 10 hours, at 3s. 2d.	£1	11
¼ bushel of Keene's cement, at 4s. 1½d. per bushel	0	1
½ pint of white knotting, at 2s.	0	1
½ firkin of size, at 3s.	0	1
Papering—		
Paperhanger, 12½ hours, at 1s. 8d.	0	10
10 pieces of paper, at 5s. 6d., less discount	1	3
5 lbs. flour for paste, at 3d.	1	3
Depreciation of plant, 5 per cent.	4	11
	£5	3

Dividing the above total by 10 gives the price per piece of 10s. 4d.; or, deducting the cost of the paper itself, gives the price for preparing walls and hanging the paper only of 6s. 2½d. The papering of ceilings can be worked out in exactly the same way, but to the cost of preparation the use and moving of scaffold must be allowed for, as described in the item for distempering ceilings. The usual discount off wallpapers is 25 per cent.

CHAPTER XVI.

THE "SUMMARY"; PREPARATION AND CARE OF DATA; PROFIT AND ESTABLISHMENT CHARGES; LABOUR-SAVING MACHINERY; PRICED SCHEDULES; APPROXIMATE ESTIMATES; "CUBE" PRICES, CONSTANTS OF LABOUR; CONCLUSION.

The Summary.—The preparation of prices in the various trades having been described, a few words as to the final price may not be out of place to those employed by builders. The totals for the different trades are brought forward and tabulated on the page headed "Summary," and the various percentages added for insurances, water, quantity surveyors' fees, and the like, and these totals should be carefully checked, for one careless mistake may render the whole of the preparatory work and the price useless. As a check, it is an excellent plan to total each separate page of the Bill of Quantities, irrespective of trades, and then to compare the total of all the pages with the total of all the trades. Many Bills of Quantities have a "cast" summary, at the end of each trade.

In fixing the final price the young surveyor must learn to exercise great self-control, and to remember that the real object of his work is to ascertain the lowest price at which the work can be executed, in a manner satisfactory to the client (or the architect), as well as profitable to his employer, and this price will not always be the lowest on the published list. It is a frequent occurrence, annoying to the builder and his estimating surveyor, after giving very careful attention to the analysis of each item, obtaining quotations for all important materials, and keeping each detailed cost as low as possible, to find that a lower tender is accepted at a price which they know will not permit the execution of good work, or leave any margin for profit. In such circumstances there is a great temptation with the next tender to reduce prices further, in order to obtain a job, especially if there has been a sequence of lost contracts.

Patience must be exercised, however, for all men of experience know that a novice can prepare a low price, but it requires many years of practice to carry out the work at a profitable price. The percentage of bankruptcies and liquidations in the building industry is still very high, and a considerable number of accepted tenders at unprofitable prices is a worse state of things than a sequence of lost contracts.

Preparation and Care of Data.—The student is strongly advised to adopt a card-index system for the accumulation of data, and as prices become obsolete, the cards can be removed and replaced with revised ones. The writer suggests that one box should contain data for basic items, as detailed in Chapter II., and that separate boxes be allocated to each trade.

Priced Bills of Quantities should be carefully filed, and to those for lost contracts it is well to attach a list of tenders for future reference. When a contract is complete, the nett cost of the work in each trade should be ascertained from the cost books, and these costs compared with the totals of the trades in the Bill of Quantities.

A small library of useful catalogues is desirable, but very few are really necessary, as special quotations should be obtained for all important items.

Profit and Establishment Charges.—In the previous chapters, nothing has been added to the prices for profit, establishment, or overhead charges in analyses, as the amount depends upon the size of the job and special circumstances. In some cases it is usual for a certain percentage to be added to each item, but many large contracting firms prefer to price estimates at nett prices, and to add a percentage for profit, establishment, and overhead charges when the total of the whole bill is known. If this latter method is adopted, it becomes necessary with accepted tenders to add this percentage later to each item, before the priced bill is deposited with the architects ; but this is not a difficult matter, and in the opinion of the writer, it is a great advantage to know the anticipated nett cost of the whole job before fixing a percentage for overhead charges. The larger the job, the less proportionately will be the cost of establishment and other charges, and, naturally, many firms are prepared to accept a lower rate of profit for large jobs than for small ones, and with very large jobs savings can be effected by organisation and extensive use of mechanical plant.

Labour-saving Machinery.—This is an important subject, and a whole book could be written thereon. In the foregoing chapters little or no allowance has been made for machinery or power-driven plant, as the data can be obtained only from actual costs. On large jobs considerable reductions in prices are possible owing to the introduction of mechanically driven concrete mixers, mortar pans, lifts and hoists, cranes, and concrete conveyers, as well as light railways; but it is obvious that the costing of such plant needs skilled advice, and in this direction the estimating surveyor must co-operate with the cost accountant and compare costs with output. An allowance must be made for the depreciation of mechanical plant, and this is often taken at 7½ to 10 per cent. on the original cost of the plant, but each machine must be considered separately.

The following typical examples of a mortar mill and a concrete mixer are given solely for the purpose of illustrating the methods advocated.

Mortar Mill.—From actual observation it was found that a mortar pan of average size, driven by a small petrol engine, required the attention of two labourers, and consumed ¾ gall. of petrol per day of 8 hours, and thus produced 11 yds. cube of mortar.

Detailed Cost. Preparation of Mortar.—

	£	s.	d.
2 labourers (1 skilled), 8 hours, at 2s. 7½d.	1	1	0
¾ gall. petrol, at 1s. 6d.	0	1	1½
Oil and grease (not more than 6d.)	0	0	6
Allowance for depreciation (10 per cent. on £150), i.e. 8 hours, at 2d.	0	1	4
	£1	3	11½

Ten per cent. on £150 is £15 per annum, and it is assumed the machine works 1800 hours per annum.

Dividing this total by 11 gives the cost of preparation as 2s. 2½d. per yard cube, which should be compared with the cost of mixing by hand as detailed in Chapter II. It must be remembered that it may be necessary to convey the mortar to the site, and this cost must be added.

Concrete Mixer.—A petrol-driven plant of a capacity of ½ yd. cube working a short distance from the job required the attendance of five men as follows. One man to attend to the machinery and water, two men to fill the skip with aggregate and cement, one man to wheel away, and one man to spread.

In these circumstances ¼ yd. of concrete was produced and laid each 5 minutes (often the time taken was but 4 minutes), thus producing 24 yds. cube per day of 8 hours. If the work is close enough to the machine, so that wheeling is unnecessary, a saving can be effected, and a further saving can be effected by using automatic conveyers, or shoots.

Detailed Cost.—

5 labourers (1 skilled, at 1d. extra), 8 hours, at 6s. 5½d.	£2	11	6
1 gall. of petrol, at 1s. 6d.	0	1	6
Oil and grease (not more than 6d.)	0	0	6
Depreciation (10 per cent. on £250), 8 hours, at 2½d.	0	1	8
	£2	15	2

The depreciation has been calculated as described in the previous item.

Dividing the above by 24 gives the cost of mixing and spreading at 2s. 3½d. per yard cube. This should be compared with the cost of mixing by hand, detailed in Chapter IV. In putting this matter before a well-known firm for their opinion, the writer was informed that the saving over hand labour was not less than 50 per cent. and on large jobs was as much as 75 per cent. The detailed cost confirms this as the saving shown is almost 50 per cent.

Electric Hoist.

If the work is above ground level, an electric hoist will effect a great saving. One under the writer's observation at the present time, taking one barrow load each journey, costs less than 2s. per day for electric current.

Joinery Machinery.—It is impossible to give even approximate prices for such plant, as different conditions occur in each shop. The prices for manufactured joinery can be fixed only as the result of accurate costing methods. As a very rough guide, however, it will be found that in a well-organised joiner's shop with ordinary machinery, the cost of the labour, including machinist, in producing any finished article of joinery in deal will amount to little more than the cost of the material itself. With up-to-date machinery and good organisation, it is possible to effect great economy, but this is a matter for works administration.

Priced Schedules.—These are prepared by various public authorities, and contractors tendering thereon are asked to name a percentage to be added to, or deducted from, the whole of the prices quoted in the published schedule. Having acted on behalf of contractors tendering for this class of work, also for public authorities inviting such tenders, the writer had opportunities for considering priced schedules from two opposite points of view, and in his opinion the use of such schedules should be restricted, for he is doubtful if they serve any very useful purpose.

It is often urged in their favour that for "jobbing" work they are an advantage from the point of view of the authority concerned, but it will be found that there are very few jobs that cannot be dealt with by small lump sum competitive estimates. One large public undertaking, known to the writer, already deals with "jobbing" work in this way, and no difficulty occurs; moreover, the builders are not put to the expense of measurement, which, with priced schedules, in some instances amounts to more than the total cost of the work measured. It has been pointed out that in course of time the different builders tendering for small jobs might get to know each other, and that collusion might result, but this could occur with any system of tendering, and can be obviated by occasionally inviting different firms. It is also claimed that for certain contracts for painting, maintenance, and similar work a priced schedule is an advantage if tenders are required quickly, but in such cases the measurements for such work are usually in the possession of the authority, having been used upon previous occasions, and there appears to be no real reason why the builders should not receive proper Bills of Quantities prepared in the usual manner. Another advantage claimed for schedules is that work can often be commenced before plans for the work are complete, as tenders can be obtained in advance, but here again the writer considers the advantage problematical. If, owing to difficulties of construction, or site, the completion of the drawings is impossible, the difficulty could be met by inviting tenders, with proper Bills of Quantities for portions of the work, such as foundations, etc., and at a later date, when completed plans are ready, tenders could be invited for the remainder of the work.

The difficulty of fixing a suitable percentage for all trades has already been mentioned in Chapter II., and certain

authorities invite percentage tenders for the separate trades; but even these are not easy to price. Without previous experience of the particular schedule, and unless he knows the class of work he may expect, it is still a matter of difficulty to fix a price, as some items are less profitable than others. In all priced schedules it is usually found that certain items may show a small profit, whilst, on the other hand, there are items which cannot possibly be carried out at the prices named, and unless these items are known to the estimating surveyor his "estimate" becomes a gamble. Contractors who specialise in schedule work find it necessary to employ a highly-trained surveyor who has made a special study of the particular schedules, so it is obvious firms tendering for the first time are severely handicapped. If the contractor and his estimating surveyor have no previous experience of this class of work, they will be well advised to refrain altogether from tendering for any work to be executed in accordance with any priced schedule. Not until some time after the work is complete is it possible to know if the transaction has been profitable or otherwise, and then it is too late to take steps to effect any economy or to decline extra work.

The fixing of the percentage to be quoted is a matter for an experienced estimating surveyor working in conjunction with a skilled cost accountant; and the junior surveyor should leave schedules alone.

Approximate Estimates and "Cube" Prices.—In order to ascertain the probable cost of a job, and as a rough check on the detailed estimate, it is sometimes necessary to prepare an approximate estimate. A surveyor often finds it necessary to prepare a rough estimate before taking out quantities, as in most instances the client is anxious to know the probable cost of the building before it is possible to invite tenders. A common method is "to cube" the building, but "cube" prices must be used with great care, although they can be of use for comparative purposes. To describe the matter briefly, the system consists of finding the cubic contents of the whole building and multiplying this total by a price per foot cube, which is found by comparing the proposed structure with a similar building. There are different methods of arriving at the total "cube," but it is common practice to measure from the bottom of the foundations to a distance half-way up a sloping roof for height. The writer prefers to find the exact cubic contents

of the roof, as so much depends upon its shape, and to add the cubic contents of chimney stacks, dormers, gables, and any other projections. The value of a list of "cube" prices obtained from known data is obvious, but it must not be forgotten that the rate of wages is the principal factor, and when comparing prices of "cube" rates the comparative rates of wages must also be considered. If the building has a flat roof the "height" should be taken as 1 ft. 6 ins. above the parapet.

In the hands of those who are not experienced, "cube" prices are most dangerous, and the student is strongly advised to use such prices simply as a rough check upon detailed work, and then only "cube" prices prepared from work observed by himself. The following few examples are taken from the writer's own records, and are for comparative purposes only, They were obtained by taking the average prices of the various tenders and similar jobs, ignoring the highest and the lowest estimates in each case. This is the writer's own system, but other surveyors have different methods, not only for finding the price but also for measuring the "cube." The prices are given as a rough guide and are not intended for use.

Type of Building.	Price per "Foot Cube." s.
Small houses	0
Additions to country houses	1 3
Additions to town houses	1 7
Factory (steel framed), with no fittings	0 4½
Shops (without shopfronts or fittings)	0 7½
Shops with flats above	1 2
High-class town flats (stone fronted)	2 0
Steel-framed office buildings	1 5

In each case the price includes all usual fitments and finishings, except where otherwise stated.

Constants of Labour.—These are given in many technical books, but practical men seldom use them. Occasionally, however, one comes across an item which is unfamiliar, and in such cases it is useful to have a basis to which one can refer, but this should not be consulted until the task has been visualised and an idea of the time required obtained. Of all the tables published, the writer is of opinion that those contained in "Hurst's Architectural Surveyor's Handbook" are still the most consistent; but it must be borne in mind that the original tables were prepared many years ago, when the working day was much longer than at present. This fact has a

greater effect upon the "Constants" than is apparent at first. The time lost at the commencement and at the completion of the day's work has to be distributed into a shorter length of time than formerly; also, the output of the men during the morning hours is not so great as when the men had a breakfast interval. In many cases, especially in large towns, the workmen have to travel some distance under trying conditions, and obviously are not so fit to commence work as they would be if they could have their first daily meal upon the job. For jobbing work, maintenance, and work of a similar nature, there is a useful table of "Constants of Labour" attached to a small book entitled "Works Manual," compiled by the War Office for the use of military foremen of works. This work is published by H.M. Stationery Office and costs less than 1s., but it is necessary to ask for the appendix, as this contains the constants; it can be obtained through any bookseller. From the remarks in the previous chapters, it will be seen that the value of tables of constants is limited.

Conclusion.—In concluding this chapter, the writer again wishes to emphasise that readers must compile their own data for each particular job in accordance with local circumstances, and that the whole of the information contained in this book, although based upon personal experience covering a period of many years, is intended to show the young estimating surveyor how to prepare such data, and to assist Quantity Surveyors, Estimating Surveyors and others preparing for the various professional examinations.

CHAPTER XVII.

EXAMINATIONS AND EXAMINATION QUESTIONS.

The Chartered Surveyors' Institution.—In Sub-division 3, Final (Quantities Section), which is the examination for Quantity Surveyors, all candidates have to take papers in "Analysis of Pricing." For permission to sit at the examination, candidates from Quantity Surveyors' offices will have little difficulty, but it may be of interest to some readers to know that candidates from certain building establishments of sufficient standing are now accepted for examination, as some young men join high-class building firms to gain experience. Such candidates, if successful, cannot become members of the Institution until they are in actual practice as Quantity Surveyors. By the courtesy of the Council of the Chartered Surveyors' Institution, the Examination Questions for 1934 and 1935 are reproduced herewith.

For permission to sit at the examination, application should be made to the Secretary, the Chartered Surveyors' Institution, 12 Great George Street, Westminster, S.W. 1.

1934 EXAMINATION.

BUILDING PRICES (ANALYSIS OF).

(TYPICAL SUBJECT.)

FINAL, DIRECT FELLOWSHIP, AND SPECIAL DEGREE EXAMINATIONS.

(*Time allowed—Two hours and a half.*)

Notes to be observed by candidates in stating and analysing prices.

The candidate is to assume that the work is to be carried out at any site where the facilities for access are normal, and that work is to be of good quality.

The analyses are to be based upon the rates of wages and prices of materials contained in the last page of this paper.

The rates and prices must be used by the candidates without question.

The prices are *not* to include for the items usually included in the Preliminary Bill, such as :—

Watching, Lighting, Offices at Site, Insurances, Hoarding, etc., *nor* for overhead charges and profit.

The analysis of prices must be set forth in detail in ink in the spaces left after the item, or on the *back* of the preceding page.

Candidates are not required to analyse prices in detail unless specifically required so to do by the question.

Excavator, Concretor, Bricklayer and Drains.

1. How many hours of labour should it take to mix, wheel, deposit and ram 1 yd. cube of cement concrete mixed in the proportions of 1 to 6? . . . .

2. How much water is required to build a rod of reduced brickwork (272 ft. superficial 13½ ins. thick)? . .....

3. State the price of a bed of breeze concrete 2½ ins. thick (1 part cement, 1 part sand, and 4 parts breeze to pass ½-in. mesh and retained on ⅛-in. mesh), spread and levelled for wood flooring? . . ..per yard super.

4. Analyse in detail the price of Question No. 3.

5. The price of a rod of reduced common brickwork in cement mortar (1 : 4) being £30 15s., analyse in detail this price.

6. State the price of hard red paving bricks laid flat, set jointed and pointed in cement mortar (1 : 3) .....per yard super.

7. State the price of excavating for and building drain inspection

chamber 2′ × 2′ and 4 ft. 9 ins. deep to invert with 9-in. brick in cement (1 : 4), sides rendered all round in cement and sand (1 : 1), 6 ins. Portland cement concrete (1 : 6), bottom spreading 6 ins. beyond walls all round and benched up with similar concrete finished and floated smooth in cement and sand (1 : 1). The benching to rise vertically at side of main channel for a height of 3 ins. and then sloped off at an angle of 30°, and include one 6-in. white glazed stoneware half-round channel and two 6-in. three-quarter round white glazed channel bends bedded in cement. Cover with a galvanised air-tight cover (p.c. £2) bedded in cart grease and sand, and build into sides three galvanised horse-shoe step irons, fill in earth around and cart away surplus and plank and strut as necessary . . . .each.

8. Analyse in detail the price of Question No. 7.

Mason and Tiler.

9. State the price of Portland stone and all labour, hoisting (not exceeding 40 ft. from ground), setting and jointing in cement and sand (1 : 3), plain plinth and cleaning down at completion . . . .per foot cube.

10. Ditto moulded door and window dressings . . . .per foot cube.

11. State the price of red sand faced roofing tiles laid to a 4-in. gauge each tile secured with two copper nails . . . .per square.

12. Analyse in detail the price of Question No. 11.

CARPENTER, JOINER, AND IRONMONGER.

13. What is "a hundred of deals"? . . . .

14. How many feet run are contained in a "customary square" of prepared flooring boards 9 ins. wide? .....

15. State the price of 2-in. deal four panel, moulded both sides, door with $4\frac{1}{2}$-in. top rail stiles and muntins and 9-in. middle and bottom rails . . . .per foot super.

16. Analyse in detail the price of Question No. 15.

17. State the price of $\frac{3}{4}$-in. deal tongued, grooved and V-jointed boarding and fixing to underside of joists as ceiling . . . .per square.

18. State the price of $6'' \times 3''$ English oak sunk, weathered, throated check, throated and grooved sill . . . .per foot run.

19 Analyse in detail the price of Question No. 18.

FOUNDER AND SMITH.

20. What is the weight of 1 ft. super of gunmetal 1 in. thick? . .....lbs.

21. Ditto brass? . . . .lbs.

22. Ditto cast iron? . . . .lbs.

23. State the price of 3-in. cast-iron rain-water pipe jointed in red lead and fixing with ears and nails to plugs in brick-faced wall . .....per foot run.

24. Analyse in detail the price of Question No. 23.

25. State the price of $\frac{3}{4}$-in. diameter steel rods cut to lengths hooked at ends and embedded in concrete as reinforcement . . ..per cwt.

PLASTERER.

26. How many "striked" bushels are there in a cubic yard? . . ..

27. What is the weight of a bushel of "dry hair"? . . ..

28. State the price of rendering, floating and setting walls in lime and hair mortar . . . . .per yard super.

29. Analyse in detail the price of Question No. 28.

30. State the price of Keene's cement, reveal 4½ ins. wide on brick with one slightly rounded arris and narrow return . . . . .per foot run.

PLUMBER.

31. What is the weight of a cubic foot of milled lead? . . . .lbs.

32. Ditto copper? . . . .lbs.

33. State the price of milled lead and all labour in 6 lbs. covering to flats . . . . . .per cwt.

34. State the price of 4-in. lead soil pipe out of 7 lbs. lead with 10 ins. 6 lbs. lead ornamental tacks soldered on and fixing to brick-faced wall with lead headed nails and plugs . .per foot run.

35. Analyse in detail price of Question No. 34.

36. State the price of unloading, getting in, hoisting and *fixing* only glazed lavatory basin with plated brackets, hot and cold valves and waste combined, overflow plug and chain complete, including jointing up fittings, plugging walls for brackets, joints of lead service and waste to fitting and all making good, complete . . . . .each.

37. Analyse in detail the price of Question No. 36.

GLAZIER AND PAINTER.

38. What is the thickness of 26 oz. glass? . . . . . ins.

39. How many square yards will 1 lb. of ready-mixed paint cover as a first coat? . . . . .yards.

40. State the price of 26 oz. clear sheet glass and glazing with putty in squares not exceeding 2 ft. super to wood . . . . . per foot super.

41. State the price of knotting, priming, stopping and painting three times in addition in prepared paint on woodwork ..... per yard super.

42. Analyse in detail the price of Question No. 41.

1935 EXAMINATION.

BUILDING PRICES (ANALYSIS OF).

(TYPICAL SUBJECT.)

FINAL, DIRECT FELLOWSHIP, AND SPECIAL DEGREE EXAMINATIONS.

(Time allowed—Two hours and a half.)

Notes to be observed by candidates in stating and analysing prices.

The candidate is to assume that the work is to be carried out at any site where the facilities for access are normal, and that work is to be of good quality.

The analyses are to be based upon the rates of wages and prices of materials contained in the last page of this paper.

The rates and prices must be used by the candidates without question.

The prices are *not* to include for the items usually included in the Preliminary Bill, such as :—

Watching, Lighting, Offices at Site, Insurances, Hoarding, etc., *nor* for overhead charges and profit.

The analysis of prices must be set forth in detail in ink in the spaces left after the item, or on the *back* of the preceding page.

Candidates are not required to analyse prices in detail unless specifically required so to do by the question.

Excavator, Concretor, Bricklayer and Drains.

1. What is the average weight per foot cube of concrete (1 part of cement to 6 parts of ballast and sand) ? . . . . lbs.

2. How many 4-in. stoneware drain pipes each 2 ft. long are there in 1 ton ? . . . .

3. State the price of excavating surface trench not exceeding 5 ft. deep, throwing out, wheeling and carting a distance of two runs and depositing in heaps . . . .per yard cube.

4. Analyse in detail the price of Question No. 3.

5. State the price of reduced common brickwork in (1 : 4) cement mortar . . . .per rod super.

6. Analyse in detail the price of Question No. 5.

Mason and Slater.

7. What is the weight per foot cube of—

(*a*) Bath stone . . .. lbs.

(*b*) Kentish rag stone . . .. lbs.

(*c*) Portland stone (base bed) ? ..... lbs.

8. State the price of 4-in. Yorkshire stone self-faced cover stones with coped edges set and jointed in cement mortar (1 : 3) on steel joists . . . .per foot super.

9. Analyse in detail the price of Question No. 8.

10. State the price of best green Westmorland slating laid in diminishing courses to a 3-in. lap, each slate nailed with two 2-in. copper nails (weighing 12 lbs. per 1000) . .....per square.

11. Analyse in detail the price of Question No. 10.

Carpenter and Joiner.

12. What length is a knot of sash line? . . . .yards.

13. State the price of 2″ × ¾″ fir sawn battens spaced for countess slating laid to a 3-in. lap . . ..per square.

14. State the price of deal cased frame 4 ft. wide and 6 ft. high, having 1-in. inner and 1-in. moulded outer linings, 1½-in. pulley stiles, ½-in. back linings, ⅜-in. English oak parting beads and slips, and ¾-in. × 1″ deal staffbeads all properly tongued and grooved together, 6½″ × 3½″ English oak sunk, weathered, rebated check, throated and grooved sill, and 1¾-in. deal moulded sashes with splayed meeting and bottom rails divided into small squares with stout rebated and moulded bars all double hung on brass-faced axle pulleys, best flax lines and iron weights . .....per foot super.

15. Analyse in detail the price of Question No. 14.

16. What is the constant of labour for carpenter fixing fir in roofs? . . . .hrs. per foot cube.

Founder and Smith.

17. What is the weight of 1 ft. super of copper 1-in. thick? . . ..lbs.

18. State the price of ½″ × 2″ round-backed wrought-iron handrail screwed to wood core rail (core rail not included), and drilling iron rail and filing heads of screws smooth . .....per cwt.

19. Analyse in detail the price of Question No. 18.

20. State the price of rolled-steel joists of basic list sections cut to lengths and hoisting and fixing 12 ft. above ground level . . . .per cwt.

PLASTERER.

21. How many "bundles" are there in a load of laths? . . ..

22. What is the weight of a bushel of Keene's cement? . . ..lbs.

23. State the price of ¾-in. Portland cement (1 : 3) rendering mixed with 5 lbs. of "Pudlo" brand waterproofing powder to every 100 lbs. of cement trowelled hard and smooth for paint . . . .per yard super.

24. Analyse in detail the price of Question No. 23.

25. State the price of lath with rent fir laths, plaster in lime and hair and float and set in plasterer's putty on ceilings . . . .per yard super.

PLUMBER.

26. What is the thickness of 6 lbs. lead? . . . .ins.

27. State the price of a soldered joint of 2 ins. to 2 ins. lead pipe? .....

28. Analyse in detail price of Question No. 27.

29. State the cost of—

No. 1 white glazed pedestal lavatory basin with hot, cold and waste valves, overflow and cast-iron brackets, p.c. 42s., and add for 1½-in. lead P trap with brass screw cleaning cap and lining soldered in, soldered joint to fitting and to 1½-in. lead waste, soldered joint to ½-in. lead cold-water service, red lead joint to ½-in. iron hot-water service pipe and fixing the whole jointing up parts and cutting and pinning brackets to wall complete . . ..

30. Analyse in detail the cost of Question No. 29.

31. What is the weight per foot super of No. 20 Vielle Montagne gauge zinc? . . . .

GLAZIER, PAINTER AND PAPERHANGER.

32. State the price of 32 oz. clear sheet glass and glazing in squares not exceeding 2 ft. super to metal with putty composed of equal parts of putty and white lead . .....per foot super.

33. Analyse in detail the price of Question No. 32.

34. What is the extreme area in which a sheet of 26 oz. glass can be obtained ? . . . .ft.

35. How many gallons are contained in a barrel of turpentine ? . .....

36. How many square yards will 1 cwt. of red lead cover ? . . ..

37. State the price of—
Scrape free from rust, clean and paint one coat of red lead before fixing and three coats of oil colour after fixing on metal surfaces . .....yard super.

38. Analyse in detail the price of Question No. 37.

39. What is the length and the net width of a piece of English paper ? . . . .length.
.....width.

40. State the price of pumicing smooth, stopping and preparing walls and hanging paper, p.c. 2s. per piece . . . .per piece.

41. Analyse in detail the price of Question No. 40.

THE CITY AND GUILDS OF LONDON INSTITUTE.

The examination held annually in "Builders' Quantities" now includes a paper on analysis of prices. The examination is open to anyone, and is a good preparation for the subject of "Quantities" and "Analysis of Pricing" for those who wish later to enter for the Surveyors' Institution. By the courtesy of the Department of Technology of the City and Guilds of London Institute, 31 Brechin Place, London, S.W. 7, the recent examination questions dealing with prices are reproduced herein. For permission to sit at this examination application should be made to the Secretary of the local education authority of the district in which the student resides. It is not necessary for

candidates to belong to a technical institute, as external candidates are accepted, but candidates would be well advised to join a Technical Institute.

It will be noticed that Part II. of this examination requires a knowledge of Builders' Accountancy and Costing.

1935 EXAMINATION.

FINAL EXAMINATION—SECTION B.

ANALYSIS OF QUANTITIES FOR PRICING.

The candidate must not attempt more than THREE *questions from Part I., nor more than* TWO *questions from Part II., i.e.* FIVE *questions in all.*

The candidate must indicate clearly both the question and the item to which each of his answers refers.

Eight sheets of ruled paper to be given to each candidate. Additional sheets may be obtained upon application to the invigilator.

Write your examination number in clear figures at the top right-hand corner of each sheet of ruled paper. Insert the sheets in your answer book before giving it up.

The maximum number of marks obtainable is affixed to each question.

PART I.

A detailed analysis on the ruled sheets supplied is required for each of the following quantity items, and the prices for materials necessary for working follow each question.

For the purpose of analysis, the labour rates are to be taken as follows :—

Bricklayer Mason Carpenters and Joiners Machinists (exclusive of machines) Plumbers	1s. 7d. per hour.
Painters	1s. 6d. ,, ,,
Labourers	1s. 2¼d. ,, ,,
Scaffolders	1s. 3½d. ,, ,,
Labourers and Mates attendant on Craftsmen	1s. 2¼d. ,, ,,

Prices are to be nett, no addition being made for profit and establishment charges.

QUESTION 1.

	Yds.	*Ft.*		
Item 1	150	—	Cube	Excavate over surface of site not exceeding 5 ft. deep and wheel or basket out and cart away.
Item 2	300	—	,,	Excavate to form basement not exceeding 5 ft. deep and do. do. and do.
Item 3	250	—	,,	Do. do. and do. not exceeding 10 ft. deep and do. do. and do.
Item 4	150	—	,,	Excavate surface trenches not exceeding 4 ft. deep and do. do. and do.
Item 5	120	—	,,	Excavate basement trenches not exceeding 3 ft. deep and do. do. and do.
Item 6	—	400	Super	Planking and strutting to sides of basement excavation 8 ft. deep (all faces measured).
Item 7	—	350	,,	Do. and do. to sides of surface trenches (both sides measured).
Item 8	—	200	,,	Do. and do. to sides of basement trenches (both sides measured).

Rubbish or excavated material carted away at 2s. 9d. per yard cube.

Timber for planking and strutting, £16 10s. Standard delivered. Assume timber of no value after six times used. (36 MARKS.)

QUESTION 2.

	Yds.	*Ft.*		
Item 9	200	—	Cube	Portland cement concrete in foundations composed of 6 parts of river ballast to 1 part of Portland cement.
Item 10	300	—	Super	6-in. layer of do. spread and levelled over site.
Item 11	150	—	,,	6-in. layer of do. do. do. do. but laid to falls.
Item 12	100	—	,,	E.O. to spade face finish as paving.

QUESTION 2—*continued.*

	Yds.	Ft.		
				River ballast, 6s. yard cube delivered.
				Portland cement in paper bags, 38s. ton delivered.
Item 13	300	—	Super	6-in. reinforced concrete floor composed of 4 parts ¾-in. crushed river ballast, 2 parts of clean gritty sand and 1 part of Portland cement, and hoisting and laying at 2nd floor level (centering and reinforcement measured).
Item 14	—	280	Cube	Reinforced concrete as above in beams average 50 ins. in sectional area and hoisting and filling around reinforcement at 2nd floor level (centering and reinforcement measured.)
	Sqs.			
Item 15	27	—	Super	Wro't centering to reinforced concrete floor and hoisting to average floor height of 10 ft.
Item 16	—	520	,,	Do. to beams and do. do. do.
	Cwts.			
Item 17	15	—	In	¾-in. reinforced rods and binding at crossings with No. 10 S.W.G. binding wire.
Item 18	7	—	,,	1-in. do. do. and do.
				¾-in. crushed river ballast, 7s. 6d. yard cube delivered.
				Gritty sand, 8s. yard cube delivered.
				Portland cement, as before.
				1¼-in. wro't centering boards, £20 15s. Standard delivered. Assume timber of no value after three times used.
				Other sections for bearers and strutting, 2s. foot cube.
				¾-in. and 1-in. rods delivered in normal lenghts, 9s. per cwt.

(46 MARKS.)

QUESTION 3.

	Rods	*Ft.*		
Item 19	40	—	Super	Reduced Fletton brickwork in cement mortar 3 to 1 (normal and average work).
Item 20	3	—	,,	Do. do. built overhand.
			or, alternatively,	
	Yds.			
Item 19a	1813	—	Super	Reduced Fletton brickwork in cement mortar 3 to 1 (normal and average work).
Item 20a	136	—	,,	Do. do. built overhand.
Item 21	—	2400	,,	Half-brick wall.
Item 22	—	480	,,	Casing to old wall half-brick thick and add for extra labour and material in cutting, toothing and bonding to old.
Item 23	450	—	,,	Fair face and point internally.
Item 24	—	840	,,	Horizontal damp-proof course of two courses of stout slates in cement.
Item 25	—	4000	,,	Extra for stock facings and neat cut and weathered joint pointing as the work proceeds, Flemish bond.
Item 26	—	700	,,	Extra for facing in 2nd quality white glazed facings and pointing in Snowcrete cement Flemish bond.
Item 27	—	130	Run	Do. for 2¼-in. bullnose angle.
Item 28	—	340	,,	Do. do. to 4½-in. reveals.
Item 29	—	120	,,	Do. do. to 9-in. reveals.
				Flettons, 56s. 1000 delivered.
				Washed pit sand, 7s. 6d. yard delivered.
				Portland cement in paper bags, 38s. ton delivered.
				14" × 9" damp-course slates, 90s. 1000.

QUESTION 3—*continued.*

18″ × 9″ damp-course slates, 120s. 1000.
2nd white glazed stretchers, £20 1000.
2nd do. do. headers, £19 10s. 1000.
2nd do. do. quoins, £26 10s. 1000.
2nd do. do bullnose, £26 10s. 1000 at station and include 10s. per 1000 extra for cartage to site.
Include for erection and striking of scaffolding, but not the value nor the cartage of scaffolding materials. (46 MARKS.)

QUESTION 4.

		Ft.		
Item 30	—	300	Cube	In 4″ × 3″ fir plates.
Item 31	—	300	,,	In 9″ × 2″ fir-framed floor.
Item 32	—	300	,,	In 5″ × 2″ fir-framed roofs.
Item 33	—	300	,,	In 4″ × 2″ and 4″ × 3″ fir-framed partition.
	Sqs.			
Item 34	30	—	Super	1-in. sawn deal roof boarding nailed to rafters and including splayed edge.
Item 35	20	—	,,	1-in. do, and including firrings average 3-in. deep.
Item 36	—	100	,,	1½-in. fir-framed ridge or hips.
Item 37	—	100	,,	2-in. do. do.
Item 38	—	100	Run	Raking, cutting and waste on 1-in. roof boarding.
Item 39	—	120	,,	Labour plugging brickwork.
Item 40	—	80	,,	Do. do. concrete.

4″ × 2 4″ × 3″, 5″ × 2″, 2s. 2d. ft. cube delivered to even feet length.
9″ × 2″, 2s. 5d. ft. cube delivered to even feet length.
1½″ × 2″ thickness, 2s. 5d. ft. cube delivered to even feet length.
1-in. sawn roof boarding, 18s. per square. (30 MARKS.)

QUESTION 5.

	Sqs.	*Ft.*		
Item 41	100	—	Super	1-in. wrought yellow batten plain edge flooring with splayed heading joints.
Item 42	80	—	,,	1½-in. do. do. do. tounged and grooved do. with do. do.
Item 43	—	530	Run	1″ × 6″ deal moulded skirting on and including grounds and backing to quarter partition.
Item 44	—	350	,,	1″ × 6″ do. as last but plugged to wall. No. 60 mitres. No. 60 fair ends. No. 60 fitted ends.
Item 45	—	120	Super	2-in. deal four panel square framed door.
Item 46	—	120	Run	4″ × 3″ deal wrought rebated and twice moulded frame.
Item 47	—	160	,,	4″ × 3″ do. do. twice rebated and four times moulded mullion or transome.
Item 48	—	160	Super	2-in. deal four panel square framed door moulded one side.
Item 49	—	120	,,	2-in. do. three panel door, two lower panels moulded both sides, upper panel open and moulded for glass in one square.

1-in. deal plain edge flooring, 20s. square, delivered.
1½-in. deal grooved and tongued flooring, 26s. square, delivered.
Joinery deal, 4½ ft. super as 1 in. thick.

Fixing only ironmongery to deal, including supplying screws to match.

Item 50.—No. 20 4-in. wrought steel butts.
No. 20 4-in. brass butts with double steel washers.
No. 20 rim locks and brass furniture.
No. 20 mortice locks and do.
No. 10 sets of panic bolts to single doors.
No. 5 sets do. to two leaf doors.
State E.O. on above if fixed to hardwood.

(36 MARKS.)

PART II.

QUESTION 6.

In the erection of a large building, a sub-contract has been placed for the erection, hire, and removal of steel scaffolding. How would you deal with this item in regard to allocation of costs? (30 MARKS.)

QUESTION 7.

What factors would you take into consideration in calculating, and how would you calculate the average charge per hour for the use of a woodworking machine? (36 MARKS.)

QUESTION 8.

What items would you include under overhead and establishment charges, and how would you take them into account in framing an estimate? (36 MARKS.)

QUESTION 9.

Assuming that your company had three lorries, how would you allocate or deal with the cost of transport to various contracts?

(30 MARKS.)

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